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ASTRONOMY DURING THE EARLY YEARS OF THE AMERICAN PHILOSOPHICAL SOCIETY[1]

By Dr. S. A. MITCHELL

LEANDER MCCORMICK OBSERVATORY, UNIVERSITY OF VIRGINIA

"IT was not without being sensible how very unequal I am to the undertaking that I first consented to comply with the request of several gentlemen for whom I have the highest esteem, and to solicit your attention to a subject which an able hand might indeed render both entertaining and instructive. I mean astronomy." These words are not my own but rather they were spoken by David Rittenhouse in an "Oration" delivered on February 24, 1775, before the American Philosophical Society. According to the minutes of the society, the oration was delivered in the college "to a crowded audience, consisting of his Honor the Governor of the Province, the Assembly, and a great number of gentlemen of the first distinction, besides the members of the Society." Moreover, the oration was dedicated "To the delegates of the Thirteen Colonies, assembled in Congress at Philadelphia, to whom the future liberties, and consequently the virtue, improvement in science and happiness in America are intrusted."

Again to quote the words of Rittenhouse:

Astronomy, like the Christian religion, if you will allow me the comparison, has a much greater influence on our knowledge in general, and perhaps on our manners, too,

[1] Address at the mid-winter meeting devoted to the Early History of Science and Learning in America with especial reference to the part played by the American Philosophical Society, Philadelphia, February 13 and 14, 1942.

than is commonly imagined. Though but few men are its particular votaries, yet the light it affords is universally diffused among us; and it is difficult for us to divest ourselves of its influence, . . .

You are all of you very familiar with the fact that the American Philosophical Society was founded in the year 1743. A valued letter from Benjamin Franklin kept in the society's library gives the names of the nine original members, with himself as secretary. (In 1743, Franklin, the fifteenth of seventeen children, was thirty-seven years old.)

At a meeting held in the State House on February 2, 1768, we read in the minutes:

A Society having subsisted for some time in this City under the name of the American Society held at Philadelphia for promoting and propagating useful Knowledge, whose Views have been nearly the same with those which are published of the American Philosophical Society, and it being judged that the Ends proposed by both could be carried on with more advantage to the Public if a Union could take place between them, it is proposed that such a Union may take place.

Accordingly during the year 1768, the society took on a new lease of life and more than 100 members were elected.

Early in the following year, on Monday, January 2, 1769, the foremost citizen of Philadelphia, Benjamin Franklin, was elected president of the society, an office he continued to hold until his death in April, 1790. David Rittenhouse succeeded Franklin as president and he continued in office until his death in June, 1796.

As your speaker to-day has lived for more than twenty-five years in Virginia on Mount Jefferson in sight of Monticello, four miles distant, I hope you will pardon me for quoting from the letter of the four secretaries of the society in advising Thomas Jefferson of his election as the society's president. Under date of January 7, 1797, the letter reads:

We have the pleasure of informing you, that at the annual Election of Officers of the American Philosophical Society for promoting useful knowledge, held at Philadelphia on the 6th inst., you were chosen President of that respectable Institution.

To this Jefferson replied:

I have duly received your favour of the 7th inst., informing me, that the American Philosophical Society have been pleased to name me their President. The suffrage of a body which comprehends whatever the American World has of distinction in Philosophy & Science in general, is the most flattering incident of my life, and that to which I am the most sensible. . . . Permit me to avail myself of this opportunity of expressing the sincere Grief I feel for the loss of our beloved Rittenhouse. Genius, Science, modesty, purity of morals, simplicity of manners, marked him one of Nature's best samples of the Perfection she can cover under the human form. Surely, no Society till ours within the same compass of time, ever had to deplore the loss of two such members as Franklin & Rittenhouse. Franklin, our Patriarch, whom Philosophy and Philanthropy announced the first of men, and whose name will be like a star of the first magnitude in the firmament of heaven, when the memory of those who have surrounded & obscured him, will be lost in the Abyss of time.

Jefferson continued as president of the society during the eight years he was President of the United States. Late in the year 1808, when he was planning soon to move from Washington back to his home at Monticello, Jefferson tendered his resignation as president of the society. His resignation was not accepted and he continued in office until January 6, 1815. Thereafter again tendering his resignation he was succeeded by Dr. Caspar Wistar.

Franklin, Rittenhouse and Jefferson between them had been presidents of the American Philosophical Society from 1769 to 1815, a space of almost half a century. The real cause of the awakening to life of the society in 1768 was literally a heaven-sent event, namely, a Transit of Venus that was most successfully observed in and near the city of Philadelphia and the genius who organized and carried the plans through to perfection was David Rittenhouse. The older members of the society have heard time and time again about Rittenhouse. To-day I wish to call briefly to the attention of the younger members and those who are not astronomers some of the high spots in the life of Rittenhouse, and at the same time to suggest to all of you that you go upstairs to the members' room and see for yourselves the astronomical clock and the transit telescope both made and used by Rittenhouse in his observations of the Transit of Venus on June 3, 1769. Also upstairs is a Dollond refractor that took part in the Transit of Venus observations and also a theodolite that formerly belonged to William Penn and which was used for laying out the City of Philadelphia.

Rittenhouse was born on April 8, 1732, in a small stone house that now stands on the main drive through Fairmount Park. Even as a boy he showed extraordinary mathematical and mechanical ability and as he grew older he was always very resourceful in supplying his own needs. He acquired great proficiency in observational, practical and theoretical astronomy and in instrument making. The construction of his first telescope dates from 1756. His first observations as an astronomer were in 1763–64 when he carried out a survey for William Penn to settle the boundary dispute with Lord Baltimore. This boundary, between the present states of Pennsylvania and Maryland, was done with such high accuracy that it became part of the Mason and Dixon line.

His early fame rested primarily on the construction

of his celebrated orrery of 1767, acquired by a college founded in New Jersey in 1746 and now known as Princeton University. This first orrery was lost, but a second one is now the proud possession of the University of Pennsylvania. For each of these instruments Rittenhouse received £300.

It is most interesting to read over the minutes of the society after its reorganization in 1768. At the meeting of March 8 held at the State House, "a fine of one shilling for non-attendance of members at meetings was ordered as a by-law of the Society. Six organic committees were then constituted by distributing the members present among the committees." At this early period in the life of the first learned society in the western hemisphere, rewards for attendance and penalties for non-attendance were put into effect. The minutes of succeeding meetings of the society furnish no information, however, regarding the amount the treasury's balance was enhanced by the one shilling fines.

At the very next meeting of the society (1768, March 22), Rittenhouse described his new orrery, and at the following meeting the committee on Rittenhouse's orrery reported that "they have the greatest Reason to expect from his known Abilities" that the orrery "will do honor to himself & to this Province, the place of his Nativity; and the Committee beg leave to recommend it to the Society to order his description to be published; not doubting but it will give Pleasure to Persons of a curious and Philosophical Turn." Hence the first paper ordered to be published by action of the society was one on astronomy, which then as now one and three-quarter centuries later had a strong popular appeal.

The description which appears as the first article in the first volume of the society's *Transactions* states that the orrery represents the motions of the sun, moon and planets, and therefore illustrates solar and lunar eclipses and other phenomena "for a period of 5000 years, either forward or backward." For showing the motions of the heavenly bodies it was the forerunner of the planetarium. Jefferson spoke of the orrery in these words: Rittenhouse "has indeed not made a world; but he has by imitation approached nearer its maker than any man who has lived from the creation to this day."

As I have indicated, it was the Transit of Venus that brought great fame to our society in its early years, and once started on the high road it has continued to function with great dignity for nearly 200 years. At the meeting on April 19, 1768, plans were started to observe the Transit from three different sites, the State House square, the Rittenhouse farm at Norriton and Cape Henlopen. In addition to Rittenhouse, other enthusiastic observers were John Ewing, provost of the University of Pennsylvania, Joseph Shippen and Hugh Williamson. The society may well be proud of Ewing. Besides being provost of the university, he was professor of natural philosophy, and it was said of him that "in the absence of any other professor, the Provost could take his place, at an hour's warning, and conduct the instruction appropriate to that Professorship with more skill, taste and advantage than the incumbent of the chair himself."

The condition at that time of the country surrounding the City of Brotherly Love may be surmised by reading from the minutes of the society that an inquiry was made "to know whether the Indians would allow proper Persons to pass through their Country in order to make the Transit of Venus observations." Perhaps the lives of the members of the expeditions sent out from this city were in no greater danger than were the lives of eclipse observers in the year 1900, for we have it on good authority that before crossing the Atlantic Ocean to witness the eclipse, the head of one of the British expeditions appealed to the United States Government to protect the lives of the party from the wild natives (sic) of North Carolina. I might add that on arriving in New York the fears were effectively dispelled when the party found themselves aboard a luxurious Pennsylvania train and discovered that they themselves, their baggage and their instruments were routed through to destination—and entirely free of charge. Of course this was in the good old days now gone forever!

For the great event, Rittenhouse had a clock which he himself had made, a transit telescope also constructed by his own hands and now considered the first telescope made in America and a refracting telescope. These instruments are now in the members' room upstairs.

For the expenses incurred in observing the Transit of Venus, the society paid more than £100 from its treasury. Thus we find that Dr. Conklin, the chairman of our research committee, has long-established precedent for paying out society's funds to aid research.

The accuracy of the observations by Rittenhouse, who was assisted by William Smith and John Lukens, has been attested by Nevil Maskelyne, astronomer royal of England at the time, and by Simon Newcomb. The latter[1] states that "his observations of the celebrated transit of Venus in 1769 have every appearance of being among the best that were made." Combination with Greenwich results by a method improved by Rittenhouse gave 8.″805 for the solar parallax, in remarkable agreement with the value 8.″803, which has been the accepted value until a few months ago when the present astronomer royal of England, H. Spencer

[1] "Dictionary of American Biography," Vol. XV, page 630.

Jones, gave the refined value of 8.″790, coming from observations made the world over on the planet Eros.

For carrying on the observations in Philadelphia the minutes read, "The Honorable House of Representatives had generously granted the privilege of erecting the Observatory in the State House Yard, and voted £100 for erection and observation to be paid to the Society Treasurer." Thus we see that the first observatory in the United States to be created at public expense dates from the year 1768.

In 1770, Rittenhouse moved to Philadelphia. His observations included transits of Mercury, solar and lunar eclipses, variable stars, the new planet Uranus (discovered by Herschel in 1781) and comets, including one discovered by himself in 1793. His work in astronomy was many-sided. To adjust instruments in the meridian, in 1785 he invented the collimating telescope, since then universally used. The same year he introduced spider threads into his telescope. In 1786 he made a plane transmission grating, thus anticipating Fraunhofer's grating by about 30 years. Newton had previously used "scratches made in polished plates of glass," but Rittenhouse measured grating intervals and deviations of several orders of spectra. He was frequently engaged in boundary surveys and commissions involving Pennsylvania, Delaware, Maryland, Virginia, New York, New Jersey and Massachusetts. Outside of astronomy, he served on the commission to organize the United States bank, and George Washington appointed him the first director of the Mint, on April 14, 1792, thus exemplifying the fact that a resourceful practical astronomer is equipped to tackle almost any job. At the University of Pennsylvania he was professor of astronomy and later trustee and vice-provost. In the American Philosophical Society he served as curator, librarian, secretary, vice-president and president. The highest of the many honors that came to him was his election, when president of our society, as a foreign member of the Royal Society. The first American to be so honored after the Revolution was James Bowdoin, governor of Massachusetts and president of the American Academy of Arts and Sciences.

As an eclipse observer myself, I wish to direct your attention to the fact that only one week after the British evacuation of Philadelphia, "The first eclipse of the sun to be carefully observed[2] in the British colonies of America was that of June 24, 1778, which was watched by the astronomer, David Rittenhouse." Although the eclipse was total, with the gorgeous beauty of the corona readily visible to the naked eye, no mention was made in the record of Nature's most beautiful phenomenon. To us at the present day, one of the strangest portions of the history of astronomy before the middle of the nineteenth century is the evident lack of interest in, or perhaps one should say the dearth of observations of the corona and of the rosy prominences visible without telescopic aid at the time of a total eclipse of the sun. The only scientific observations made were the accurate times of the contacts of the limbs of the sun and moon. At a total eclipse of the sun there are four contacts. Similar observations are still made at eclipses, the purpose being the perfection of the motion of the moon, which even to-day is an erratic member of the sun's family. Possibly for this reason the moon is always designated by the feminine gender.

In the midst of the revolutionary war, in 1778, life in Philadelphia evidently went on about the same whether the British soldiers were present in the city or not. That was ages before we had heard of the word "schrecklichkeit" or of "the scorched earth."

The next total solar eclipse visible in the United States was only two years later, on October 27, 1780; it was not total in Philadelphia but was total in New England. This eclipse is memorable for two distinct features. It was the occasion of the first American eclipse expedition, under Professor Williams, of Harvard College. I think you will be interested in hearing some of the details from my own book, or as published in *Memoirs American Academy of Arts and Sciences*, 1, 84, 1783. The account by Williams reads:

> Though involved in all the calamaties and distresses of a severe war, the government discovered all the attention and readiness to promote the cause of science, which could have been expected in the most peaceable and prosperous times; and passed a resolve, directing the Board of War to fit out the Lincoln galley to convey me to Penobscot, or any other port at the eastward, with such assistants as I should judge necessary.

When the great day arrived, the Harvard party found itself outside the path of totality. However, an observation of great value was made, as you may learn from the following.

> The sun's limb became so small as to appear like a circular thread or rather like a very fine horn. Both the ends lost their acuteness and seemed to break off in the form of small drops or stars some of which were round and others of an oblong figure. They would separate for a small distance, some would appear to run together again and then diminish until the whole disappeared.

Here is a clear description of the eclipse phenomenon known to all of you as Baily's beads, as the result of observation by Francis Baily, a London stock-broker at the eclipse more than a half-century later, in 1836.

Another total eclipse of the sun, that of June 16, 1806, was again visible in Massachusetts but not in Philadelphia. This might be regarded as an instance of undue partiality to the rival scientific society in Boston, the American Academy of Arts and Sciences. However, I have been pleased to find that a member

[2] "Eclipses of the Sun," page 128.

of the American Philosophical Society, Andrew Ellicott by name, also described Baily's beads thirty years before the 1836 eclipse. The description I have never before seen published nor referred to. I found it in the "Manuscript Communications," Vol. 2, page 57, in a letter from Andrew Ellicott, part of which reads:

> Those detached luminous points of the sun's limb seemed to retain their brilliancy till the instant of their disappearance, which it would appear should not be the case, if the moon was surrounded with an atmosphere—those points particularly, which are formed by depression in the moon's limb would have had their splendour somewhat diminished by the density of the atmosphere, if one existed,—but nothing of the kind was observed.

In the same collection of manuscripts in the society's library, and four pages after Ellicott's letter I found another letter regarding the 1806 eclipse, this time from Simeon De Witt of Albany, N. Y., the contents of which pleased me mightily. The letter reads:

> With this I send you for the American Philosophical Society a painting intended to represent the central Eclipse of the Sun on the 16th of June last. It is executed by Mr. Ezra Ames, an eminent portrait painter of this place and gives I believe as true a representation of that grand and beautiful phenomenon as can be artificially expressed. The Edge of the moon was strongly illuminated and had the brilliancy of polished silver. No common colors could express this; I therefore directed it to be attempted as you will see by a raised silver rim which in a proper light produces tolerably well the intended effect.
>
> As no verbal description can give anything like a true Idea of this sublime spectacle with which man is so rarely gratified, I thought this painting would not be an unwelcome present to the Society or an improper article to be preserved among its collection of subjects for philosophic speculation.

A little more than a century later I myself was a Simeon De Witt and was instrumental in discovering another eminent portrait painter, Howard Russell Butler, who was with me in Oregon for the total eclipse of June 8, 1918. Again the artist and the astronomer engaged in team-work, as had been done for the eclipse of 1806, Mr. Butler in the ten days before the eclipse doing the difficult task of attempting by his skill as an artist to bring out the fire and the glory immediately surrounding the moon in the inner corona, the astronomer doing the easy task of criticizing as the result of experience gained at three previous total eclipses. Most of you have seen Mr. Butler's famous paintings of the eclipses of 1918, 1923 and 1925. For the first and third of these eclipses he was with me. He was near me at the 1923 eclipse but "unusually unusual" clouds in "beautiful sunny California" prevented him from being with me. The originals of the paintings form a triptych at the Hayden Planetarium of the American Museum of Natural History, and copies by Mr. Butler are in the Franklin Museum in this city and in the building of the National Academy of Sciences in Washington.

Andrew Ellicott (1754–1820) has been to me a most interesting character. He was of Dutch and English Quaker stock and belonged to the family that founded Ellicott City, Maryland. He was a mathematician and a surveyor and therefore an astronomer. In 1784, he was appointed member for Virginia for the group of surveyors that continued the Mason and Dixon line southward. In 1791, he began the survey, occupying two years, that gave the boundaries of the ten-mile square tract ceded by Maryland and Virginia as the site of the present District of Columbia. In 1811, Georgia invited him to run the line between that state and South Carolina. When the job was finished, Georgia refused to pay him more than his expenses for the simple reason that his line ran 18 miles farther south than Georgia's hopes. He appears to have had many stormy times in his career, but he found a haven of rest in 1813 at West Point, where he was professor of mathematics.

I have quoted from one of Ellicott's letters. Another was written from Lancaster, to Thomas Jefferson, president of the United States and of the American Philosophical Society, under date of December 29, 1801. Part of the letter reads:

> I enclose a few astronomical observations. . . . Being now the only native of the United States left, which time has not spunged (sic) away, and who has cultivated practical astronomy for the purpose of rendering it useful to commerce, to the division of territories, and the determination of the relative positions of the different parts of our own country, I feel a desire to keep the subject alive, till succeeded by some American, whose fortune may put it in his power to be more useful, by allowing him to devote his whole time to the improvement of so important a branch of science.

The observations referred to are chiefly lunar distances to check up on the lunar theory and to determine the longitude. From these and other letters, I have come to the conclusion that he had a fairly high opinion of his own importance and that he was at times a bit difficult to get along with, perhaps a bit cantankerous. It has been said of him that "He had a happier hand with the theodolite than he had with the pen."

In spite of some shortcomings Ellicott was a most careful observer. At the eclipse of 1806 he determined the difference in longitude between Lancaster and Greenwich. The value obtained exceeded that derived earlier by 17 seconds of arc. He gave the correct explanation for this difference, namely, "imperfections in the lunar tables, which appear to give the moon's longitude at the time of the eclipse at least 1′ too much. The error in latitude at the same

time is almost insensible." Also he correctly pointed out that by noting the northern and southern limits of the moon's shadow path on the earth, "observations were made for the express purpose of correcting the lunar tables." The most perfect results following this plan were at the total eclipse of January 24, 1925, when the southern edge of the moon's shadow was accurately determined at Riverside Drive in New York City. At the top of the apartment house at 96th street and south of the street the eclipse was not total, but north of the comparatively narrow street the corona was visible and the eclipse was total. The edge of the shadow of totality was, therefore, pinned down to within two hundred and twenty-five feet on the west edge of Manhattan Island.

Going back once more to the early minutes, we find the following, noted for the meeting of 1769, September 15. "Dr. Williamson delivered to the Society a paper in which he endeavored to explain the theory of the motion of the Comets, the probability of their being inhabited, etc." This paper was referred to the Committee on Astronomy with instructions that they "publish it if they think proper without reporting." The publication appeared in *Trans.* (O.S.) 1, 1771, appendix 27–36.

My audience to-day will smile at the apparently absurd idea that comets might ever be thought to be habitable. But let us stop a minute and look back. In 1715, the great Halley[3] thought that the appearances on the eastern and western edges of the sun at a total eclipse might reasonably be expected to be different, for the reason that "the eastern limb of the moon had been exposed to the sun's rays for a fortnight, and as a consequence it would be natural to expect that the *heated lunar atmosphere* might exert some absorbing effect on the solar rays while on the contrary the western edge of the moon being in darkness and cold for two weeks could exhibit no such absorbing action." Of course we now know that the moon has no atmosphere. A half-century or more later, one of the greatest men in observational astronomy of all time thought that the dark spots on the sun might be openings into the cooler portions of the sun that even might be habitable. To Herschel, astronomy owes the great reflecting telescopes, to him we owe the discovery of the planet Uranus, and to him and to his son Sir John we owe tremendous advances, particularly in stellar astronomy. Herschel's telescopes (judged by modern standards) were very crude affairs. It was not until 1817 that the art of glass-making had advanced enough to permit Fraunhofer to construct the "great Dorpat refractor," as it was called, with the then unprecedented aperture of 9½ inches.

This review of astronomy in the early years of the society would not be complete unless I called to your attention the enormous difference in an observatory then and now. At the present time an observatory may mean a 200-inch telescope and six millions of dollars. In the eighteenth century an observatory meant a structure costing a few hundred dollars, with a telescope small and crude, the telescope usually fixed in the meridian, chiefly to determine time and to assist in surveys of the virgin country. Most of these, like that on the State House Square, had a transitory existence. The first observatory belonging to a college was not erected near Philadelphia or New York or anywhere in the North, but south of the Mason and Dixon line. I have told you of the all-round ability of John Ewing, provost of the University of Pennsylvania. To illustrate the fact that Virginia never takes second place to any state in the Union (I should add that I am not a Virginian by birth) I would like to tell you a little about a contemporary of Jefferson, by the name of James Madison (1749–1812). At the age of 28 he became the president of the College of William and Mary, the second oldest college in the United States, and later he was the first bishop of the Protestant Episcopal Church in Virginia. In the year 1780 in November, he sent to Rittenhouse observations of the eclipse of Jupiter's satellites and the value of the longitude from Paris derived therefrom. In volume 3 of the *Transactions,* page 150, reference is made to the "observatory" and to observations made of a lunar eclipse on November 2nd and of a Transit of Mercury on November 5, 1789.

The second observatory in this country was likewise not in the North but in the South, at the University of North Carolina. Joseph Caldwell was born in 1773 and graduated from Princeton when only 18 years old. At the age of 23 he went to Chapel Hill as professor of mathematics and at the age of 31 he became president of the university. In the year 1824 the trustees of the university had enough confidence in their president as to give him $6,600 and to send him to Europe to buy books and laboratory apparatus; the money spent was about equally divided between books and instruments. The equipment was chiefly astronomical and consisted in a meridian transit telescope, an altitude and altitude telescope, a refracting telescope, a good clock with a mercurial pendulum, a sextant, a Hadley's quadrant and a portable reflecting circle. An observatory was built in 1830 and 1831, largely at President Caldwell's own expense. Its cost is given as $430.29½. Unfortunately, the construction was not very solid, and the roof leaked. After President Caldwell's death, the building deteriorated and it burned in 1838. The instruments, however, were saved. My friend, Dr. MacNider (of the University of North Carolina), writes me, "I wish so much you could see these beautiful old instruments. The brass

[3] *Phil. Trans.*, 29, 248, 1715.

is one of the softest, loveliest things in the form of a metal that I have ever looked at." Some of Sherman's soldiers on their march to the sea passed through Chapel Hill. They too admired the lovely finish of a telescope found on a dusty shelf in one of the laboratories. In picking up the telescope tube to examine it more closely, they found something loose inside, which turned out to be two gold watches placed by professors for safe keeping in the securest place imaginable. Needless to say, the watches were immediately appropriated. When the soldiers had left the laboratory, the professors returned to wind up their watches, only to find no trace of them. The loss was at once reported to the commanding officer. The story does not end there, and furnishes another triumph for the course of true love. It is said that the commandant was in love with the daughter of the president. The gold watches were promptly recovered and were returned to their rightful owners.

In the North, Yale University in 1830 secured a 5-inch Dollond refractor of 10 feet focus. There was no observatory. The telescope was pulled around in the Athenaeum Tower and pointed through one of the windows. Unfortunately, the windows were low and no object more than 30 degrees above the horizon could be observed. Similarly, Harvard College[4] possessed astronomical instruments from an early date but no astronomical observatory. Harvard College Observatory was established in October, 1839.

As might have been expected, astronomy, the so-called queen of the sciences, played a most important part in the early years of the American Philosophical Society. And this was so, largely because astronomy more than any other science of 150 to 200 years ago was useful in the promotion of useful knowledge. To-day, when some of us can get along very well with a very inexpensive watch, we perhaps forget that before the days of the electric telegraph the only manner of ascertaining exact time was to make astronomical observations. Although exact time and topographic surveys were necessary as useful knowledge, the only astronomers whose names have lived throughout the two centuries are those who pursued knowledge for the useful purpose of gaining information about matters with no immediate practical application to business or to mundane affairs.

The history of astronomy of our society, revealed through manuscripts in our valuable library in the Drexel Building across the street, includes a few outstanding names of men who gained valuable knowledge regarding the distance to the sun or who progressed a step further toward solving Nature's secrets, through observations of eclipses of the sun or moon or of Jupiter's satellites.

And now in closing I wish to state that I am not vain enough to believe that you have found my review of astronomy "both entertaining and instructive," to quote the words of David Rittenhouse, even though I did find my brief excursion into the early history most entertaining and instructive to myself.

OBITUARY

ARTHUR NEWELL TALBOT

1857–1942

ARTHUR NEWELL TALBOT, professor of municipal and sanitary engineering, emeritus, at the University of Illinois, died in Chicago on April 3 after a short illness. Although he had retired from formal university duties in 1926, Dr. Talbot had continued his active interest in research and in engineering society affairs, and was attending the annual meeting of the American Railway Engineering Association when stricken on March 17. Just a year previously he had relinquished the direction of the association's investigation of stresses in railroad track, a project that he had actively conducted for 27 years.

Born in Cortland, Illinois, and educated at the University of Illinois, he graduated in civil engineering in 1881. After four years of railroad engineering in the West, he returned to teach in the university in 1885. He was made professor of municipal and sanitary engineering and placed in charge of theoretical and applied mechanics in 1890. Thenceforth, his achievements are acknowledged to have "contributed more to the development and distinction of that college and its engineering experiment station than the work of any other man."

Dr. Talbot was a pioneer in engineering education and research in this country. He made numerous contributions to engineering practice in sewage disposal and sanitary engineering, in drainage and water supply, in surveying and railroad construction, in materials testing and specifications, in the construction of sewers, pavements, bridges and buildings, and in many allied fields. Beginning in 1903, he conducted extended researches in reinforced concrete and did much to establish this new building material on a rational and scientific basis of design. This work and his 27-year study of the problems of design and maintenance of railroad track are probably his greatest achievements in the field of engineering research.

Dr. Talbot was active in many engineering and scientific societies. He was a past-president and honorary member of the American Society of Civil Engi-

[4] W. I. Milham, "Early American Observatories," *Popular Astronomy*, 45: 523, 1937.

neers, the American Society for Testing Materials and the Illinois Society of Engineers. He was also an honorary member of the Institution of Structural Engineers, the Western Society of Engineers, the American Water Works Association, the American Concrete Institute and the American Railway Engineering Association. He was a very active member of the Society for the Promotion of Engineering Education, and held various offices, including that of president. He was also a member of the Institution of Civil Engineers (London), the American Society of Mechanical Engineers, the American Public Health Association and the American Association for the Advancement of Science.

Among other honors, Professor Talbot received the degrees of D.Sc. from the University of Pennsylvania, 1915; D.Eng. from the University of Michigan, 1916; and LL.D. from the University of Illinois, 1931. He was also the recipient of many medals and awards, including the Washington Award, Western Society of Engineers; the Henderson Medal of the Franklin Institute; the Turner Medal, American Concrete Institute; the Lamme Medal, Society for the Promotion of Engineering Education; the Fritz Medal, United Engineering Societies; and bronze plaques from the American Railway Engineering Association. In 1938, his work in developing a great materials research laboratory and staff was recognized by the University of Illinois by renaming the building in his honor, the Arthur Newell Talbot Laboratory.

A great engineer, teacher and director of research, Dr. Talbot was loved and respected for his quiet dignity, his broad technical interests and intellectual curiosity, his high ideals, his inspiring standards of thoroughness and precision, and for his kindly spirit of helpfulness and genuine interest toward all with whom he came in contact.

F. E. RICHART

UNIVERSITY OF ILLINOIS

RECENT DEATHS

WALTER F. REYNOLDS, chief of the section of triangulation of the Division of Geodesy of the U. S. Coast and Geodetic Survey, died on May 1. He was sixty-one years old.

EDWARD C. GROESBECK, metallurgist of the Division of Metallurgy of the National Bureau of Standards, died on May 8 in his sixty-first year.

SCIENTIFIC EVENTS

SCIENTIFIC RESEARCH IN SWEDEN[1]

EXTENSIVE research activity is going on in Sweden, in order to find substitutes for products which can no longer be imported owing to the war. One of the most important centers for this research is the Physical-Chemical Institute, Uppsala, headed by Professor The Svedberg. The institute has now lost all the foreign research workers who used to study there, with the exception of one Swiss; nevertheless the staff has been doubled. Extensions have in particular been made to departments dealing with the many present supply problems, of which the chemical aspects fall within Professor Svedberg's own department, namely, the giant molecules. The work with different kinds of synthetic rosins and cellulose-derivatives is now progressing on a large scale. Among other objects of research may be mentioned bread. Experiments are being made to find a means of replacing imported hard wheat, which was formerly used to improve the baking qualities of bread made from Swedish native soft wheat. Investigations are also being carried out on synthetic rubber. The work has proceeded so far that the product has been evolved in the laboratories of the institute, although it is too early yet to say whether domestic production can be started and its probable extent.

One of the foremost technical means of research of this institute is the Svedberg ultra-centrifuge, which has become of the utmost importance to science. The rotor of this centrifuge is given a speed of up to 70,000 revolutions per minute by a number of oil turbines. The institute also houses such instruments for research as one of the world's largest electro-magnets and a neutron generator, both of which have been made in Sweden. In the biochemical section the experiments for locating and cultivating infantile paralysis virus and tuberculin on the basis of a new method for analyzing mixtures through molecule splitting are carried on under the direction of Professor Arne Tiselius, who has devised this method. The object in the first place is to obtain a pure form of virus. The stoppage of the import of apes for these experiments for a while threatened the workers with the loss of indispensable test animals, but it is stated that their replacement with rats has now proved acceptable.

[1] From *Nature*.

THE WARTIME SERVICE OF HARVARD UNIVERSITY

THE *Harvard Alumni Bulletin* gives the following information in regard to the wartime service of the members of the faculty.

To describe in a few words the modification of the university to the needs of wartime becomes inevitably a recital of facts and figures—a story which has been unfolding for many months. The faculty has accepted the

duty of leading the university to war. President Conant, whose clear-voiced challenge was one of the first heard in the United States in the present fight for freedom, now serves part-time in Washington as chairman of the National Defense Research Committee. Dean Landis of the Law School heads the Office of Civilian Defense. Dean Spaulding of the Graduate School of Education holds the rank of Lieutenant Colonel as special consultant to the War Department in Army educational problems. The dean of the Medical School, Dr. Burwell, serves as chairman of a sub-committee on the procurement of medical officers and research workers. Dean Drinker, of the School of Public Health, aids important research in the problems of flying at high altitudes.

Among the teaching members of the faculty, Professor William Y. Elliott of the department of government is director of the Raw Materials Division under William L. Batt, of the War Production Board. Many other professors of the departments of government, history and economics are employed full-time by the War Production Board, the Office of the Coordinator of Information and various important branches of the Government, lending their specialized skill to the intricate problems of war.

Even more might be said of the scientific departments of the university, could the story be told. A wide variety of confidential Government war projects are carried on in the strictest secrecy in the laboratories to the north of the Memorial Hall delta; in the workrooms of the Medical School or Business School. Much of this work is under contract with the Office of Scientific Research and Development.

Others on the faculty who can not contribute to scientific work or active Government research are devoting themselves to programs of public information. Some 1,300 members of the faculty belong to American Defense-Harvard Group, pioneer war organization of the university, many of whose services have become a permanent part of the university's program. In addition to a War Service Information Bureau (headed by Professor A. J. Casner, of the Law School) five other important official groups aid students in their search for information about war work or make available to the public significant background material concerned with the progress of the war. The committees are: Selective Service (headed by John M. Russell, assistant to the president, only last week called to active duty as a Captain in the Army Air Corps), furnishing to students official information about the Selective Service law and aiding them in their formal relations with local boards; Civilian Defense (headed by Donald Scott, '00, director of the Peabody Museum), organizing the defense precautions of the university and planning the security of its resources; Wartime Speakers (headed by Acting Dean Henry W. Holmes, '03, of the School of Education), furnishing men with specialized knowledge for speeches before civic groups; Wartime Public Opinion (headed by Robert Lasch of the Omada *World Herald* and composed of Nieman Fellows) assisting the university with reports on wartime public opinion; and Pan-American Relations (headed by Professor Clarence H. Haring, '07, Master of Dunster House) caring for Latin-American students and arranging suitable programs for Latin-American visitors in the United States and American visitors in Latin America.

The entire faculty has by voluntary action placed itself on a year-round schedule without increase in pay, a step involving actual loss of income to many teachers obliged to surrender valuable summer jobs or consultative work. Their personal sacrifice is one answer to President Conant's pledge of "all resources of Harvard University" to insure a speedy and complete victory.

THE ACCELERATED PROGRAM OF MEDICAL SCHOOLS

As a war measure, programs have been initiated to increase the supply of physicians for the Army, Navy and civilian population by the adoption of an accelerated program of medical education by the various medical schools of the country. The *Journal* of the American Medical Association reports that in connection with the adoption of such programs, the Council on Medical Education and Hospitals of the American Medical Association, the Association of American Medical Colleges and the Federation of State Medical Boards of the United States in February, 1942, adopted resolutions as follows:

Council on Medical Education and Hospitals of the American Medical Association.—The council is of the opinion that the adoption of a program for an accelerated curriculum for approved medical schools during this war period is a decision which should be determined by each medical school.

The decision of a medical school to initiate an accelerated curriculum should be made only after a comprehensive survey of the personnel, facilities and equipment of the school and its ability to give a medical education without deterioration of the quality of the medical instruction and in conformity with the statutes of the various states and the rulings of the state medical boards.

The council stands ready to make necessary inspections whenever in its judgment such inspections are required to maintain the present high standards of medical education.

The council believes that financial assistance for needy medical students during the accelerated program is best provided through scholarships or loans.

Association of American Medical Colleges.—The executive council requested approval of the recommendations sent to the deans of member colleges December 18 and December 23, 1941, urging member colleges, which can do so without any lowering of present standards of medical education, to go on an accelerated program of instruction on or about July 1, 1942.

Attention is called to the fact that the executive council recommended that only those medical colleges that can do so without lowering present standards of medical education should adopt the accelerated program. This applies not only to the utilization of the summer as a teaching period but also to the interval at which freshman classes are admitted; that is, whether annually or at approximately nine-month intervals.

The executive council recommends that the accelerated program consist of four full academic sessions of not less than thirty-two weeks each and that graduation shall not follow sooner than thirty-five months after first matriculation as a freshman.

The executive council recommends that as many colleges as can do so start instruction of the next freshman class on or about July 1, 1942, and subsequent freshman classes at approximately nine-month intervals until July 1, 1945.

The executive council recommends that, in admitting students for the accelerated program, eligibility requirements for admission be not lowered from the present minimum standards set by the Association of American Medical Colleges.

The Association of American Medical Colleges requests that the Federation of State Medical Boards recommend to its members that they arrange to make whatever changes are necessary in state licensing laws and/or board regulations to legalize licensure of students graduating under the accelerated program adopted by medical schools to meet the needs of the national emergency.

Federation of State Medical Boards of the United States.—WHEREAS, As a war emergency measure several approved medical schools of the United States are contemplating accelerating the courses of medical education so as to comprise four full academic sessions of at least thirty-two weeks each and that at least thirty-six months shall elapse between the beginning of medical instruction and graduation; and

WHEREAS, The medical schools initiating such an accelerated curriculum will be able to maintain the personnel, facilities and equipment necessary to give a medical education without deterioration of the quality of the medical instruction and in conformity with the statutes and licensure regulations of their respective states and territories of the United States and the District of Columbia; and

WHEREAS, The proposed accelerated course of medical education as a war emergency measure is expected not to extend beyond the present period of war emergency; therefore be it

Resolved, That the Federation of State Medical Boards of the United States in annual session assembled in Chicago, February 17, 1942, hereby endorse the proposed accelerated course of medical education and recommend it in principle as a war emergency measure for favorable consideration by the licensing authorities of the several states and territories of the United States and the District of Columbia.

In adopting these resolutions, all three agencies emphasized the importance of the maintenance of high standards of medical education in connection with any program adopted.

THE SEVENTY-FIFTH ANNIVERSARY CELEBRATION OF THE TORREY BOTANICAL CLUB

THE seventy-fifth anniversary celebration of the Torrey Botanical Club will be held from June 22 to 27 at Columbia University, the New York Botanical Garden, the Brooklyn Botanical Garden and the Boyce Thompson Institute for Plant Research, Yonkers. The history of the institutions at which the meeting is held will be given at the opening session of each as follows:

The History of Botany at Columbia University, by Dr. John S. Karling, professor of botany.

The History of the New York Botanical Garden, by Dr. William J. Robbins, director.

The History and Organization of the Boyce Thompson Institute, by Dr. William J. Crocker, director.

The History of the Brooklyn Botanic Garden, by Dr. C. Stuart Gager, director.

During the week symposia are planned as follows:

June 22 *Symposium on Morphology:* Speakers: Dr. F. T. Lewis, Dr. C. E. Allen, Dr. R. H. Wetmore and Dr. E. W. Sinnott.

June 23 *Symposium on Taxonomy:* Speakers: Dr. H. A. Gleason, Dr. H. K. Swenson, Dr. E. D. Merrill and Dr. F. D. Kern.

June 24 *Symposium on Growth:* Speakers: Dr. L. O. Kunkel, Princeton, N. J., Dr. P. W. Zimmerman and Dr. Oscar Riddle.

June 25 *Symposium on Genetics:* Speakers: Dr. George H. Shull, Dr. Stanley Cain, Dr. George M. Reed and Dr. A. F. Blakeslee.

Dr. Robbins will give a public lecture at the American Museum of Natural History on the afternoon of June 24. It will be entitled "Plants Need Vitamins Too."

The anniversary banquet will be held on the evening of June 22. There will be luncheons, inspection tours of the gardens and laboratories and a two-day field trip under the direction of Dr. John H. Small, of the New Jersey College for Women.

SCIENTIFIC NOTES AND NEWS

ACCORDING to a United Press dispatch, the Russian Academy of Sciences has elected to honorary membership three Americans and two Englishmen, the first foreigners to be so honored since the Russian revolution. The Americans are Dr. Walter Bradford Cannon, George Higginson professor of physiology at Harvard University; Dr. Gilbert Newton Lewis, professor of chemistry, and Dr. Ernest Orlando Lawrence, professor of physics, both of the University of California. The Englishmen are Sir Henry Hallett Dale, president of the Royal Society and director of the National Institute for Medical Research, and Dr. John B. S. Haldane, professor of biometry, University College, London.

AT its fifty-seventh annual meeting in Atlantic City,

the George M. Kober Medal of the Association of American Physicians was presented to Dr. Donald D. Van Slyke, member of the Rockefeller Institute for Medical Research, New York. Dr. Van Slyke was cited in recognition of "his contributions to the treatment of diabetes and Bright's disease, as well as for his work on the oxygen treatment of pneumonia."

THE Willard Gibbs Medal meeting of the Chicago Section of the American Chemical Society will take place at the Stevens Hotel on May 22. Thomas Midgley, Jr., vice-president of the Ethyl Gas Corporation, recipient of the award, will deliver an address on "A Critical Examination of Some Concepts in Rubber Chemistry."

THE award for "distinguished service in the interpretation of higher education" of the American College Publicity Association was presented on May 9 at the closing session of the twenty-fifth annual convention to Watson Davis, director of Science Service. He was cited for his "years of faithful interpretation of research in science and its translation into terms understandable to the reading public with no loss of dignity or essential meaning."

THE Howard Taylor Ricketts Prize of $200 of the Division of the Biological Sciences of the University of Chicago has been awarded to Dr. José Oliver-Gonzalez, a Puerto Rican by birth, research associate at the university, in recognition of his work indicating that trichinosis is caused by two forms of parasite and therefore immunity to the disease can be produced only by the formation of two antibodies. The prize was established in 1913, in honor of Dr. Howard Taylor Ricketts, of the University of Chicago, who discovered the cause of Rocky Mountain spotted fever. He died in 1910.

AT the annual Buckstone Browne luncheon of the Royal College of Surgeons, London, honorary fellowship was conferred on Professor Antoni Jurasz, dean of the Polish Faculty of Medicine of the University of Edinburgh.

PURDUE UNIVERSITY conferred on May 3 the honorary doctorate of science on Francis Eugene Bibbins, chief pharmacist of Eli Lilly and Company, Indianapolis.

DR. HERBERT F. PRYTHERCH, director of the U. S. Fishery Biological Laboratory at Beaufort, N. C., was elected to the presidency of the North Carolina Academy of Science at its recent annual meeting in Greensboro.

AT the twenty-seventh annual meeting of the South Dakota Academy of Science held at the University of South Dakota, Vermillion, on May 1 and 2, the following officers were elected for the coming year: Dr. Edwin H. Shaw, Jr., University, *President;* Dr. Orin Lofthus, Augustana, *First Vice-president;* Dr. Lester Guss, State College, *Second Vice-president;* and Dr. A. L. Haines, University, *Secretary-Treasurer.* Dr. Walter F. Loehwing, head of the department of botany of the State University of Iowa, was the guest speaker. His address was entitled "Recent Advances in Botanical Research." The academy will meet next year at Huron College.

DR. CHARLES N. FREY, director of research of the Fleischmann Laboratory of Standard Brands, Inc., was elected chairman of the New York Section of the American Chemical Society at the annual meeting on May 8. Professor Vincent du Vigneaud, head of the department of biochemistry at the Cornell University Medical College, was chosen chairman-elect to take office in 1943.

DR. GEORGE BLUMER, since 1920 David P. Smith clinical professor at Yale University Medical School, was elected president of the Association of American Physicians at the Atlantic City meeting. He succeeds Dr. James H. Means, Jackson professor of clinical medicine at the Harvard Medical School. Dr. Warfield T. Longcope, of the Johns Hopkins University, was elected vice-president; Dr. Joseph T. Hearn, Cleveland, secretary, and Colonel Hugh J. Morgan, of the U. S. Army Medical Corps, councillor.

KARL P. SCHMIDT, chief curator of the department of zoology of Field Museum, Chicago, was elected at the New York meeting president of the American Society of Ichthyologists and Herpetologists. Mr. Schmidt has been appointed a special lecturer for a period of three years in the department of zoology at the University of Chicago.

THE Virginia Chapter of the Sigma Xi held its annual meeting at the University of Virginia on May 5. Twenty-six members were initiated. Lieutenant-Commander Thomas F. Ball, U. S. Naval Academy, was elected from the alumni and Professor Charles Henderson from the faculty of the University of Virginia. The annual speaker was Dr. Forest Ray Moulton, permanent secretary of the American Association for the Advancement of Science.

PROFESSOR RALPH S. HOSMER, since 1914 head of the department of forestry of Cornell University, will retire on June 30.

DR. H. W. KOSTMAYER has been named to serve as acting dean of the School of Medicine of Tulane University of Louisiana during the absence of Dean Maxwell E. Lapham, now on assignment in the Navy.

DR. J. MONTEATH ROBERTSON, senior lecturer in physical chemistry at the University of Sheffield, has been appointed Gardiner professor of chemistry at

the University of Glasgow. He will succeed in October Professor T. S. Patterson, who has been for forty years a member of the department. Dr. Robertson was from 1928 to 1930 a Commonwealth fellow at the University of Michigan and at the Gates Chemical Laboratory of the California Institute of Technology.

THE War Department has activated the 118th general hospital unit, which is one section of the Johns Hopkins University Hospital Unit. It will be under the command of Colonel George Finney, the son of Colonel J. M. T. Finney, who was at the head of a similar unit in France during the last war.

DR. DINSMORE ALTER, director of the Griffith Observatory, Los Angeles, has been called to active service as Colonel of Coast Artillery in the Army of the United States. During his absence, Dr. C. H. Cleminshaw, the assistant director, will be acting director.

DR. JULIAN HUXLEY, whose post as secretary of the Zoological Society, London, was suspended by the council for the duration of the war while he was lecturing in the United States, has returned to England. At the annual meeting of the council on April 29 a body of fellows nominated Lord Horder for the presidency and Dr. Huxley for the secretaryship, which they say was "illegally" suspended.

THE *News Bulletin* of the Institute of International Education states that Dr. Hernane Tavares de Sá, professor of biology at the University of São Paulo, is making an eight-month tour of the United States during which he expects to visit seventy-five North American colleges and universities. The Institute of International Education and Westminster College, Fulton, Mo., have cooperated in awarding to him a travel fellowship for a study of the educational systems of the United States.

DR. EUGENE M. K. GEILING, professor of pharmacology at the University of Chicago Medical School, will deliver the eighth and last Harvey Society Lecture of the current series at the New York Academy of Medicine on May 21. He will speak on "The Comparative Anatomy and Pharmacology of the Pituitary Body."

THE James Arthur Lecture was given on May 14 at the American Museum of Natural History by Dr. George Pinkley, of the department of comparative anatomy of the museum. The lecture was entitled "A History of the Human Brain."

LORD RAYLEIGH delivered on April 16 the first Sir Joseph J. Thomson Memorial Lecture of the British Chemical Society.

THE annual meeting of the American Home Economics Association will be held in Boston from June 21 to 24. Dr. George R. Minot, director of the Thorndike Memorial Laboratory of the Harvard Medical School, will be among the speakers.

THE twentieth annual meeting of the American Institute of Chemists will be held on May 16 at the Hotel Claridge, Atlantic City, N. J. New officers will be elected at the business meeting in the morning. The afternoon meeting will be devoted to a symposium on "The Chemical Industry at War," with the following speakers: Dr. Gustav Egloff, Universal Oil Products Company, "The Petroleum Chemist at War"; Dr. Donald Price, technical director, National Oil Products Company, "The Chemist in To-day's Industry"; Dr. A. B. Ray, Carbide and Carbon Chemicals Corporation, "The Technical Point of View"; and Colonel O. C. Wyman, liaison officer, third Regional Labor Supply Committee, "The Chemical Industry, Selective Service and the War Effort." The medal of the institute will be presented to Dr. William Lloyd Evans, professor emeritus of the Ohio State University, at a banquet to be held in the evening. Dr. H. B. Hass, head of the department of chemistry of Purdue University, will discuss the "Career of the Medalist." Dr. Evans's acceptance address is entitled "Some Chemical Reactions of the Reducing Sugars in Alkaline Solutions."

THE ninety-third annual session of the American Medical Association will be held in Atlantic City from June 8 to 12. The House of Delegates will convene at 10 A.M. on Monday. The sixteen scientific sections of the association, the Medical Corps of the Army, the Medical Corps of the Navy and the Public Health Service are entitled to one delegate each. The Scientific Assembly will open with a general meeting, to be held at 8 P.M. on Tuesday, June 9. The sections will meet on Wednesday, Thursday and Friday, June 10, 11 and 12. Dr. Frank H. Lahey, Boston, is president of the association. The president-elect is Dr. Fred W. Rankin, of Lexington, Ky.

THE annual spring meeting of the Pennsylvania Conference of College Physics Teachers was held on April 17 and 18 at Immaculata College, Pennsylvania. One hundred and forty-two delegates representing thirty-five colleges were in attendance. The Reverend J. Joseph Lynch, S.J., chairman of the department of physics of Fordham University, addressed the conference on "The Interior of the Earth" on Friday evening. The Saturday morning program was given over to a symposium on "Physics During the War and Post-war Peace" conducted by Dr. Wheeler P. Davey, professor of research physics at the Pennsylvania State College.

ON the occasion of the meeting of the American Mathematical Society in Chicago on April 17 and 18 there was read a telegram from a group of Russian

mathematicians addressed to all American mathematicians, expressing feelings of scientific unity and a belief in the triumph of our common cause.

Nature reports that the Parliamentary Secretary of the British Ministry of Information (Ernest Thurtle, M.P.) opened a conference of British scientific and technical institutes on March 9 at which Sir John Russell, adviser to the Soviet Relations Branch of the Ministry of Information, took the chair. The conference, which took place in the rooms of the Royal Society, was called to discuss an intensification of the exchange of technical and scientific information between the U.S.S.R. and Great Britain. Some sixty scientific organizations and learned societies of Great Britain sent representatives to the conference, and it was decided to set up a standing committee to assist the Ministry of Information in this work and to act as a clearing-house between organizations in Great Britain and the U.S.S.R. A representative of the Soviet Government will be invited to join the subcommittee.

M. N. SHAFFNER, secretary and treasurer of the Field Conferences of Pennsylvania Geologists, states that the opinion of many of the members appears to be that in view of the accelerated schedule in many schools and the rubber shortage, it is doubtful if a meeting in 1942 would be well attended. Therefore, it has been decided to postpone the meeting until 1943, and probably for the duration of the war.

DISCUSSION

AN UNTRIED METHOD OF FEDERAL REAPPORTIONMENT

SINCE 1928, when SCIENCE opened its columns to a discussion of the best method of Federal reapportionment several problems then before the country have been solved and several new issues raised.[1] Two bills on the subject have become laws[2] and for some years at least no more legislation is likely. The time is ripe, therefore, for a survey of the gains and the outlook.

The gains include:

(a) A guarantee against a repetition of that failure to reapportion after a decennial census which aroused Congress and the country between 1920 and 1930.

(b) A check since 1910, probably a permanent check, upon the steady enlargement of the House under which it grew between 1790 and 1910 from 106 to 435 seats, a decennial average of 27 seats.

(c) A reduction in the number of methods mentioned in the law of 1929 from two to one, thus decreasing the likelihood that Congress will have to struggle again with the troublesome problem of method.

(d) A probability that each future apportionment will be made automatically, thus withdrawing a time-consuming subject from the floor of Congress.

The issues still open concern three questions:

(1) What is the best method of apportionment?

(2) Can a process of slight automatic decrease in the size of the House after each census be started?

(3) Can the rapid growth of rotten borough Congressional districts in a few States which State legislatures have failed to stop be ended by Federal legislation?

I must not ask for space in your columns to explain these gains or even to examine at length the second or third of the open issues. About the second let me say only that if the words in the law of 1929 "under an apportionment of the then existing number of Representatives" should be changed to "under an apportionment of five (perhaps even ten) less than the existing number of Representatives" such a change would not endanger the automatic feature of the law and would start a process of reducing the size of the House towards the three hundred members often mentioned in Congressional debates as a desirable but unattainable goal.

A longer amendment requiring approximate equality in the population of Congressional districts would stamp out the growing evil of rotten borough Congressional districts. That the evil is serious appears from the following figures of the average percentage of excess in the population of the largest Congressional district over that of the smallest in the same State.

Date of census	Average percentage of excess
1900	41
1910	54
1920	86
1930	107

Both of these amendments I may be able to explain and defend in quieter times before the appropriate Congressional committees.

But as neither of these changes is of especial interest to scientists I pass them by to raise again two fundamental questions about method. (1) What should the scholar regard as the best method of apportionment? (2) How would that method be regarded by Congress?

The two outstanding men in American history who have examined the question of method are Thomas Jefferson, who had charge of the first census, and Daniel Webster. The method of major fractions which was introduced in 1910 and has now been super-

[1] For earlier contributions to this discussion see SCIENCE, 67: 509, 1928; 68: 579, 1928; 69: 163, 272 and 356, 1929; *Sociometry*, 4: 278, 1941.

[2] Acts of June 18, 1929, Sec. 22, and amending Act of November 15, 1941.

seded by the method of equal proportions is a modernization of Webster's plan. The method I now prefer, the method of smallest divisors, is a modernization of Jefferson's. Like all modern methods but unlike Jefferson's it starts by assigning one Representative to each State because it interprets the phrase "each State shall have at least one Representative" as requiring that procedure. The seats of these 48 who might be called constitutional Representatives are as much outside the control of Congress as are those of the Senators. It is only after this initial step has been taken that the process of Congressional or statutory apportionment can begin. All modern apportionment tables like those prepared by the Bureau of the Census begin with Representative number 49 not with Representative number 1. If we accept this as a starting point it follows that in every Congress there are two groups of Representatives, a constitutional group—one for each State—among whom population counts for nothing, and a statutory group among whom population counts for everything.

In this group of 48 constitutional Representatives with which apportionment starts the one from New York stands for 122 times as many constituents as the one from Nevada. The object of Congressional or statutory apportionment which then begins should be to reduce this inequality as rapidly and completely as possible. It can best be done by giving each Representative after number 48 to the State which at that point has the largest population per Representative. All methods give seat number 49 to New York and seat number 50 to Pennsylvania, but thereafter the results diverge. The only test by which Congress judges a method is its results. The difference in result of the five methods examined in 1929 by a committee of mathematicians appointed by the National Academy of Sciences appears when we consider how Representatives, numbers 51 and 52, are apportioned by each. After seat number 49 has been assigned to New York and seat number 50 to Pennsylvania the situation is as shown in Table 1.

TABLE 1

State	Number of Representatives	Population per Representative (in thousands)
Nevada	1	110
.....		
New York	2	6,740
California	1	6,907
Ohio	1	6,908
Illinois	1	7,897

The method of greatest divisors and the method of major fractions give seat number 51 to New York, raising its total to 3; each of the other methods gives it to Illinois. Every member of Congress and the overwhelming majority of citizens would probably say that of these four States Illinois has the strongest claim to seat 51 and that any method giving it to New York should be discarded.

After Illinois has received a second seat the other three States would stand as in Table 2.

TABLE 2

State	Number of Representatives	Population per Representative (in thousands)
Nevada	1	110
.....		
New York	2	6,740
California	1	6,907
Ohio	1	6,908

The method of equal proportions and that of the harmonic mean give a third seat to New York before Ohio or California receives a second. Here again the average member of Congress doubtless would regard the claim of both States to a second seat as coming ahead of that of New York to a third. If so, the method of equal proportions and the method of the harmonic mean should also be discarded and that of smallest divisors adopted.

The test of fairness which appeals most strongly to the average Representative probably is the approach to equality in the population or average population per district in the 48 States. Next to this is a wish to keep the average of the State averages as low as possible. Tried by either test the method of smallest divisors comes out better than that of equal proportions. Under the 1940 conditions the average of the State averages by the method of equal proportions is 294,000, by that of smallest divisors 283,000, and the range between the average population per district in the State where it is largest and that where it is smallest under the method of equal proportions is 249,000, but under that of smallest divisors 207,000.

A disadvantage of the method of smallest divisors is that it transfers to the group of small States several seats which by any other method would go to the group of large States. This results from the advantage it gives to the small States in the group of 48 constitutional Representatives, an advantage not counterbalanced later as from that point on no advantage is given to either group. Whether this disadvantage would outweigh the advantages already mentioned must be left for Congress to decide. Here we are concerned only with theoretical considerations and those I believe count heavily in favor of this novel method.

A closing word about nomenclature. I have accepted the names preferred by mathematicians, although to the average Representative they carry no meaning. For that reason mainly I prefer the following:

The Thomas Jefferson approach 1790–1830	= method of greatest divisors
The Daniel Webster approach 1840	= method of major fractions
The Samuel Vinton approach 1850–1900	= Vinton method
The sliding divisor approach 1910–1930	= modernized Webster method
The mathematical approach 1940	= method of equal proportions
The double method approach ?	= modernized Jefferson method

WALTER F. WILLCOX

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TICK PARASITES ON CAPE COD

DURING the summer of 1926 the chalcid fly *Hunterellus hookeri* How., with which *Ixodiphagus caucurtei* du Buyson has been shown to be identical,[1] was released on the island of Naushon in southern Massachusetts by Larousse, King and Wolbach,[2] in an attempt to control the American dog tick, *Dermacentor variabilis* Say. Specimens of this fly were taken on the island the following summer. Furthermore, a parasitized tick was found there in 1929 by Hertig[3] in a lot of some 400 nymphs of *D. variabilis*. The parasites were not identified.

In July and early August of 1940, 1,470 engorged immature ticks were collected on Naushon Island. Of these 90 per cent. were *D. variabilis*, 513 larvae and 841 nymphs, and the remainder were of the genus *Ixodes*, 113 larvae and 23 nymphs. The *Ixodes* that reached the adult stage proved to be *I. ricinus scapularis*, and it is believed that the others were the same. One larva of *D. variabilis* yielded two specimens of *Ixodiphagus texanus* How. This is believed to be the first report of this species as a parasite of the American dog tick. But it is not the first record in this part of the country, for the U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine, has a number of records from Oak Bluffs, Massachusetts, in *Haemaphysalis leoporis-palustris* and *Ixodes dentatus*.

Hunterellus hookeri was not found parasitizing any of the above-mentioned ticks. However five adults were collected in the hair of a Setter dog, two about July 28 and three about August 20. Since the average life of an adult is about forty-eight hours, there probably is a fairly large population of the fly on the island, which is principally parasitizing some species other than *D. variabilis*. The only previous report of adults seen in nature is by Cooley.[4] It is felt that the introduction of *H. hookeri* is not a useful measure for the control of the American dog tick.

I am indebted to Dr. A. B. Gahan and Dr. C. N. Smith, of the Bureau of Entomology and Plant Quarantine, for assistance with the identifications; and to Dr. H. S. Forbes for hospitality and assistance.

SIDNEY COBB

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[1] A. B. Gahan, *Proc. Ent. Soc. of Wash.*, 36: 89, 1934.
[2] SCIENCE, 67: 351, 1928.
[3] A. Hertig, personal communication.
[4] *Onderstepoort Jour. Vet. Sci.*, 3: 23, 1934.

THE EFFECTIVE PRESENTATION OF SCIENTIFIC REPORTS

CONGRATULATIONS to Professor E. F. DuBois, of Cornell University Medical School, for the intriguing and worthwhile discussion which he has precipitated by his note of March 13 in SCIENCE on the effective oral presentation of scientific material.

The additional comments of John B. Lucke, Gilbert Dalldorf and Jean Broadhurst in SCIENCE for April 10, reveal further thinking on this truly commendable topic of discussion.

Perhaps no group of men in the country are more aware of the deficiencies of scientific papers, as read at many science meetings, than are the members of the National Association of Science Writers; those professional journalists who devote their full time to the reporting of the news of science and who attend, constantly, the major science meetings of the nation.

As a member of the National Association of Science Writers, and with the past benefit of many discussions with its members on this very subject, the following suggestions are offered for the research scientists.

The greatest fault of scientists would appear to be that they try to present material orally which is intended primarily for publication in a technical magazine.

No matter how skilled an orator a man may be, the unwise choice of words for spoken delivery can not overcome this basic handicap. The technical terminology of almost any phase of science is certainly near the peak of boredom for the human ear.

Lack of skill in oral presentation is a handicap, but one can not chide the research scientist too much on this score, for he has other things to do beside taking elocution lessons.

Nor can one expect a scientist to rehearse his address with the intensity of the director of a radio program who has nothing else in the world to do.

What scientists can do, however, is to rise above the laziness whereby they try to kill two birds with one stone. More effort needs to be made to tell their research story simply and with a minimum of technical terms which seem to be the trademark of any technical report at a scientific meeting.

If reports to scientific meetings are intended for later publication, as many of them are, let there be two drafts made of them; one to be mailed to the editor of

a technical journal and the other summarizing the findings for quick and compact oral presentation.

Actually, many of the reports to any large scientific meeting—say the Christmas meetings of the American Association for the Advancement of Science—never see permanent record in print.

Space available in technical journals to-day is much too precious to record, for all posterity, every obscure and minor advance of science. These minor papers, which make up the bulk of almost any meeting, can serve their function best if they are presented most attractively to the listening audience, for that is about as far as they will go; that and perhaps the title, and a short abstract in the program of the meeting.

In preparing an effective oral presentation of their subject-matter it might be wise for scientists to adopt something of the technique of the professional science writers who place the question, "What does it mean?" at the top of their list of requirements.

Every one, layman and scientist alike, is interested in what any new discovery in science means to the broad path of progress. That is why the newspaper reporting of science for the layman emphasizes the significance of a discovery in the very first paragraph. If the significance were buried at the end of the paper, in the fashion of a scientific report, no one would ever bother to read it.

Scientists may not like to hear it put so bluntly but, seriously, no one in the world cares what they are doing, or how they did it or even who did it. All people are interested in about any scientific discovery is, "What does it mean?"

The technical details, occupying so great a part of technical scientific reports, interest only other specialists in that particular field. The rare exceptions are those reports important enough to have wide applications in other fields of science.

This situation is true even within a given branch of science and in physics—as an example—the boredom among the electrical experts when the band spectroscopists are talking is equalled only by the boredom among the latter, when the former speak. The same thing might well be said of the various specialists in the medical sciences when they listen to each other's papers.

All this means that a scientist, in reporting his work to a scientific society, might come to the meeting armed with two manuscripts. One would be his technical paper that he hopes may some day appear in print; the kind of report which he now reads to a bored audience. This report he would keep out of sight in his innermost pocket. Its sole use would be for those very few interested individuals who come up to him after the talk for more technical details.

The other manuscript would be his oral presentation. It would tell the story of his work in a simple, summary fashion with the emphasis on what has been accomplished, rather than on how it was done. It would be intended to tell the story for *intelligent* but *ignorant* laymen, for scientists—outside their own specialized niche in science—are just that. As such they are interested in what a new discovery means rather than the specific details of how it was done.

Mr. Lucke, in his comments in SCIENCE for April 10, rightly takes scientists to task for "reading" their reports in a fumbling, halting fashion.

However, most scientists, if they will prepare their material simply for oral presentation and use a minimum of scientific terms, will find that they will be able to "read" their papers with effectiveness and with interest to their audience.

Scientists are obviously too busy—or should be too busy—with their research to have time to take a course in public speaking (although if their reputation rises to such a degree that they are in demand for many addresses they ought to consider this possibility).

However, mere reading of a statement written in oral English, in contrast to written and scientific English, can be very effective.

The best spokesman in the world to-day is President Roosevelt. He *reads* his fireside chats. Not every one can be a Roosevelt in radio or speaking style, but every one can say things simply. Every one can avoid the laziness, for that is what it is, of trying to kill two birds with one stone by trying to read a complex scientific article whose ultimate end is to appear in print in a scientific publication. Even the President couldn't do that and make any one enjoy it.

ROBERT D. POTTER,
Science Editor, The American Weekly

SCIENTIFIC BOOKS

ROTATIONS IN PSYCHOLOGY AND THE STATISTICAL REVOLUTION

Factor Analysis. A Synthesis of Factorial Methods. By KARL J. HOLZINGER and HARRY H. HARMAN. Chicago: The University of Chicago Press. 1941. $5.00.

AMONG 24 variates the number of correlation coefficients is $24 \times 23/2 = 276$, and one might perhaps imagine that about half of these would be positive and half negative. Actually, when Holzinger and Swineford worked out the correlations among 24 mental

tests given to a large group of school children they found 275 positive correlations, mostly of substantial magnitude, and only one negative correlation, which had the insignificant value −.075. Eight bodily measurements made by Dr. F. Mullen on 305 fifteen-year-old girls yielded 28 correlations, all of which were positive and of significant size. These facts, which could be paralleled in many other cases, point to the existence of underlying factors or causes common to the several tests or measurements. The girls who were big around the chest were also, on the average, bigger around the waist and had longer arms and legs than those smaller than the average in chest girth. In other words, some girls were big in general and some were small in general, though what was directly measured was in each case not general size but one of its many manifestations. The students who were good at word meanings were also good at addition and at counting groups of dots; in fact they were, on the average, better on everything on which they were tested than were their classmates who were less good at word meanings or in other individual tests. This and many similar observations constitute clear proof of the existence of something in the nature of general mental ability, varying from person to person, and affecting the degree of success attained by the person in anything he tries within a very extended category of mental activities.

When it is once recognized that an aggregate of such measurements is to a considerable extent a set of different measures of the same thing, the problem arises of choosing suitable weights for combining the several measures in order to arrive at the fundamental variate underlying all of them as nearly as possible. At this point there is a good deal of indeterminateness for lack of a universally acceptable criterion as to what constitutes the best possible set of weights. A semblance of agreement is reached because of the fact that any set of *positive* weights applied to the positively correlated measures gives a weighted mean that might plausibly be taken to represent general intelligence or whatever the underlying common factor may be. But when deviations from such a weighted mean are correlated there is also evidence in the residual correlations of further common factors, quite independent of the first one considered. In tests of school children, for example, there seems to be a common quality, independent of general intelligence and secondary to it in effect on total variance, that represents a contrast between verbal ability on the one hand and arithmetical ability or speed on the other. Indeed, there is evidence of several sorts of ability or differences of contrasting abilities, which so to speak must be measured in different dimensions, since they are statistically independent of one another, though they all contribute in varying measure to success in the tests. But to identify such fundamental "factors," to specify them as definite functions of the test scores, and, above all, to give them names, requires something on which different workers have not been able to agree.

A large number of schemes for the statistical treatment of such problems has been proposed. The volume now at hand is a compendium of most of them, with a good account of their bases and mutual relations, including the rotations of axes involved in getting from one to another. The introductory chapter includes an excellent discussion of certain relevant phases of scientific method in general. Matrix algebra and n-dimensional geometry are essential in this subject, and the reader is provided with introductions to these and some other mathematical topics in special sections. An extraordinarily clear elementary treatment is given of rotations in n dimensions. Correlated as well as uncorrelated sets of "factors" are discussed, there is a chapter on the estimation of the values of the factors for individuals in terms of their test scores, and some essential indeterminacies in the problem are duly indicated. There is an appropriate emphasis on the criterion of "parsimony," that is, on the desirability of using the smallest possible number of variates to describe a phenomenon. However, this criterion is apparently overlooked in the preference shown for types of solution involving not only general factors common to several tests or all of them, but also individual factors specific to each test and not entering into any other. Thus the whole number of factors used is actually greater than the number of tests, though the original object was to represent a large number of tests by a small number of factors.

This subject of "factor analysis" has received much attention from psychologists in recent years, and is altogether fascinating. Its potential applications go far beyond the domain of psychology. It is in fact a branch of the theory of multivariate statistical analysis, which is in turn a branch of the theory of statistics, and has applications in the most diverse fields in both natural and social sciences. Unfortunately, this logical position has frequently been overlooked by workers in factor analysis, who have treated it as a branch of psychology, and have therefore not thought it necessary or worth while to keep in touch with the rapid advances that have been taking place in multivariate analysis and in general statistical theory. The result is that factor analysis, after a brilliant start years ago, has come to be surrounded by an aura of obsolescent statistical methods, concepts and terminology. Its isolation from the main body of statistical

theory has left factor analysis in a state which can not exactly be described as stagnation, since there is so much activity, but also can not be regarded as wholly healthy.

The work of R. A. Fisher on the theory of estimation, and that of J. Neyman and E. S. Pearson on testing hypotheses, have rendered obsolete the criteria for selection of a statistic used in most textbooks on statistics and by most factor analysts. The sampling distribution appears instead as the fundamental basis from which must be derived the choice of a statistic and the method of testing a hypothesis, governing the whole investigation from start to finish. Factor analysis persists in the old habit of regarding sampling distributions as luxuries to be considered after everything else is done, if at all. Modern statistical theory aims at getting exact sampling distributions, sometimes succeeds and, in case of failure, examines a variety of approximations with a clear consciousness of the distribution that is to be approximated. In this whole comprehensive treatise on factor analysis there is not one exact sampling distribution, nor any more modern basis for the sampling theory than the Pearson-Filon paper of 1898. Criteria such as those of maximum likelihood, minimum variance and uniformly most powerful tests lead modern statistical theory to recommend as the bases of calculation functions found by applying the methods of the calculus to the determination of maxima and minima of well-defined functions of the observations. Something of this concern with maxima and minima appears in factor analysis, but is much obscured by the injection of hypothetical "communalities" and the like into the data in such a way as to vitiate accurate statistical discrimination between rival hypotheses.

One bit of fallacious reasoning seems in the past to have affected a good deal of thinking about factor analysis and multivariate statistical theory in general, and to have given the subject a directive impulse that still persists. If p measurements are made on each of N individuals drawn from a normally distributed population at random, and are plotted as coordinates of N points in p dimensions, the swarm of points tends to have a sort of ellipsoidal shape. If $p=3$, for example, the typical ellipsoid along which the density of probability for these points is a constant may have any shape from that of a sphere to that of a pancake or a needle. In the last cases the distribution may be thought of as approximating a distribution in two dimensions or one. The problem has therefore been propounded more than once of finding a sampling distribution for testing by means of a sample the hypothesis that the distribution is really of fewer dimensions than the number p of variates measured. Such efforts are completely futile. If all the points of a population on which three variates are measured lie in a plane, then every sample from this population lies in the same plane. Conversely, if a sample of more than three points is coplanar, we may conclude that the population is coplanar because in the contrary case the probability of coplanarity of the sample would be zero. Hence there is no problem of a sampling distribution here. But factor analysts have written as though they thought that the deviations of actual observations from the values they compute on hypotheses of smaller dimensionalities could be ascribed to sampling errors. A dubious passage on pages 21-22 of the current volume is perhaps in this category, though another interpretation may also be possible. The reasoning in this passage is, on either interpretation, unsatisfactory.

When it is realized that no deviations from coplanarity, however small, can be explained as sampling fluctuations, it is necessary for the factor analyst determined to represent a number of variates by a smaller number of factors to find some other yardstick for these deviations. One such yardstick, which I suggested in 1933, is provided by the errors of measurement estimated by the reliability coefficients of the tests. Many psychologists, however, have felt that to judge hypotheses by a comparison of the main effect considered with mere errors of measurement is too much like letting the tail wag the dog, and have not used this standard. In order to explain the manifest fact that the dimensionality of the set of observations is actually the number of variates, and no less, they have resorted to highly unsatisfactory "communalities" associated with "specific factors" whose existence does not seem particularly clear on *a priori* grounds, and which is not tested by the statistical methods used.

Another possible yardstick which I also suggested in 1933 is in a theory of the variates themselves as a random sample of a hypothetical aggregate of variates endowed with a probability distribution. This theory has not been developed since then, though it must be essential to the vital problem of finding factors that shall in some sense be invariant when the set of tests used is replaced by a new set. This last question is mentioned, far too briefly, on pages 107–8 of the present volume.

On page 112 a solution is obtained for the coefficients of a general factor in terms of the observed correlations. This appears to be only one of infinitely many solutions of this problem, all satisfying what Fisher calls the criterion of consistency. It provides for the coefficient a statistic that is a function of all the observed correlation coefficients, and in this sense uses all the information in the sample; but it is not

clear that it uses all the information in the sample in Fisher's sense of having minimum standard error. Once this problem of obtaining a consistent statistic with minimum standard error is understood, its solution should not be outside the range of reasonably possible straightforward mathematical research; and it is just possible that the solution might turn out to be that given. A related point is that the "least square" criterion on page 115 might well be replaced by minimizing another quadratic form whose matrix is the inverse of the covariance matrix of the triads.

The achievements of factor analysis so far seem to be in the nature of promise, and of challenge to further research in mathematical statistics. Complete methods have not yet been achieved which can be recommended to workers in the empirical sciences without reservation, or with the expectation that they will permanently be regarded as the best possible. Empirical problems, especially in psychology and neighboring fields, will certainly play a part in shaping the direction of the research necessary to put the required methods into final form. But the research will necessarily be a matter of mathematical statistics, for which no combination of psychology and matrix algebra, even with the addition of the other subjects conventionally taught in university mathematics departments, can be adequate unless the progress already made in mathematical statistics itself is utilized.

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SOCIETIES AND MEETINGS

BIOLOGY AND MEDICINE IN THE WAR[1]

IN conjunction with the meetings of the Federation of American Societies for Experimental Biology, the Boston and Cambridge Branch of the American Association of Scientific Workers presented a symposium entitled "Biology and Medicine in the War."

Dr. Maurice B. Visscher, of the department of physiology of the University of Minnesota, discussed the problem of organizing biological research in wartime. Despite the general belief that the present war is the province of the physicists alone, biologists have the opportunity, he said, of making important contributions to the national effort. Not only may biological research aid in lessening the effects of war, but on the offensive side it may assist in solving the problems of combat in desert, tropical or arctic conditions, as well as in determining the factors necessary to elicit maximal performance of fighting men. Dr. Visscher pointed out that while biologists might be inducted into service and assembled in huge central laboratories, such action would delay research while laboratories were being constructed and would seriously deplete the teaching staffs of the universities. He described as short-sighted the view that practical problems should not be attacked until projects have been assigned and contracts drawn up. He emphasized that devotees of pure science should not insist on "research as usual"; on the contrary, scientists as enlightened individuals have a greater responsibility for the national welfare than have other members of the community.

Dr. Carl W. Walter, of the Harvard Medical School, defined six major concerns of war medicine: the control of epidemic disease, the care of the wounded, the organization of civilian preparedness, the acceleration of medical education, the maintenance of adequate nutrition and the coordination of research. The problems of the epidemiologist have been increased by the possibility of rapid transport of the vectors carrying communicable disease from one geographic point to another. War of movement has made necessary a new concept of military medical service, since the surgeon must now follow the mobile forces instead of remaining behind the lines in a base hospital. Other changes in military surgical practice include the insistence upon expert treatment of minor injuries and the emphasis now placed upon methods of treatment which yield ambulatory convalescents. The accelerated program of medical education presents serious problems because it not only requires a return to the strictly didactic type of instruction, but also deprives the student of time in which to mature.

Dr. Lucien Brouha, of the Harvard Fatigue Laboratory and formerly of the University of Liège, discussed the lessons which must be drawn from the attempts to organize biological and medical research in France during the first months of the war. There "secrecy" was imposed to such an extent that no scientist knew exactly what problem he had to solve, nor what progress was being made by other workers engaged in similar research. Lack of liaison between the various laboratories and between scientists and the armed forces was a fatal mistake, repetition of which must be avoided in this country at all costs. Dr. Brouha stressed the necessity of utilizing the scientific power of the nation to the utmost. Quality of the war material and of the soldiers who use it is as important, if not more important, than quantity. While the quality of the material depends upon technical achievements, the quality of the men depends upon the wise use of biological and medical knowledge in their selection, nutrition and care.

[1] Symposium at a meeting of the Boston and Cambridge Branch of the American Association of Scientific Workers, April 3, 1942.

Dr. Harry Grundfest, of the Rockefeller Institute for Medical Research, called for a cooperative effort on the part of scientists in working out and submitting plans for war research projects. Such an effort by the members of the New York Branch of the association has already brought most satisfactory results. Of these projects the first two to be submitted have already been approved and work has been begun under OSRD authorization. He reported the suggestion that college courses in organic chemistry be reorganized to permit the synthesis by students of chemicals which are likely to become scarce. This project and the scheme for lease-lend of scientific apparatus which has been worked out by the Purdue Branch of the association are other excellent examples of the work which can be accomplished by collective planning.

The discussion which followed served only to emphasize the fact that biologists as a group are dissatisfied with their present relatively inactive part in the war effort. The view that biological and medical research should be "frozen" for the duration was severely criticized; on the contrary, the importance of forming groups for the immediate purpose of planning and organizing war research was repeatedly stressed.

J. E. HAWKINS, JR.

HARVARD MEDICAL SCHOOL

REPORTS

FIRST REPORT OF THE WAR POLICY COMMITTEE OF THE AMERICAN INSTITUTE OF PHYSICS

REPRESENTATIVES of U. S. Government agencies, institutions of learning, the press and various national associations are turning more and more frequently to the American Institute of Physics for information, advice and cooperation from physicists as a national group. These appeals present opportunities for national service. It falls within the designated scope of the institute to grasp such opportunities, but in order to do so it must first clearly understand the place of the science and the profession in the affairs of the nation and the world. Then it must accept the responsibility of speaking with authority about physics, of reflecting truly the wise consensus of physicists.

The war has brought new problems and rapid changes. It has placed physics in an important position; in fact, its present and potential contributions may well have a profound effect on the course if not the outcome of the war. The institute has thereby acquired the responsibility of keeping abreast of changes, and of presenting to those concerned with the applications of physics and the use of physicists in the war effort a currently valid and accurate portrayal of the science and the profession.

To meet these necessities the institute established a War Policy Committee for Physics, with power to direct the "external" activities in which the institute engages on behalf of the profession. The members of the committee are: Dr. Oliver E. Buckley, president of the Bell Telephone Laboratories; Dr. Karl T. Compton, president of the Massachusetts Institute of Technology; Dr. Homer L. Dodge, dean of the Graduate College, University of Oklahoma; Dr. R. C. Gibbs, chairman of the department of physics, Cornell University, and Dr. Paul E. Klopsteg, president of the Central Scientific Company, *chairman*. Dr. Henry A. Barton, director of the institute, is secretary of the committee.

There follows a report of certain conclusions and recommendations of the committee:

(1) PROFESSIONAL STATUS OF PHYSICISTS

Recent developments in technical and industrial trends have brought physicists into a position of importance in industry not heretofore existing. The present situation requires a more clear-cut definition of "physicist." The War Policy Committee has adopted the following definitions as a basis and guide for its work, and they are recommended to the Founder Societies for adoption:

(a) A *physicist* is one whose training and experience lie in the study and applications of the interactions between matter and energy in the fields of mechanics, acoustics, optics, heat, electricity, magnetism, radiation, atomic structure and nuclear phenomena.

(b) To qualify as a *professional physicist* one must have had at least eight years of training and experience in physics. Toward this experience four years of formal collegiate education with major emphasis on physics may be credited, year for year, if it leads to a bachelor's degree, five years if it leads to a master's degree, and seven years if it leads to a doctor's degree, from a recognized institution. Years of teaching of physics in a recognized institution may be credited as years of experience in physics. By a *recognized institution* is meant one which appears in the list of institutions approved by the Association of American Universities.

(2) TRAINING IN PHYSICS FOR THE WAR

New tools of war have been devised which can swing the tide of victory. They utilize results of research in electronics, electric waves, acoustics, mechanics and optics. Physicists have devised these new tools, engineers have shaped them for manufacture, and manu-

facturers are producing them. Men are needed to make the best use of them, to test and maintain them, to improve them and to devise new ones. These men are of many kinds, from high-school graduates to doctors of philosophy, but one thing they must have in common—knowledge of the fundamental laws of physics on which the operation of these tools depends.

Training in physics for all these operations and at all these levels is urgently needed.

(3) Emphasis upon the Study of Physics

Even before the war the place of physicists in industry was becoming increasingly recognized. This is made evident by available statistics concerning the growing number of physicists employed in industrial laboratories, and the expanding membership lists of national societies in the field of physics. In the last two years, as a result of war requirements, the need for physicists, as compared with other professions, has grown very rapidly. Recent estimates indicate that the need is now growing at the rate of 1,500 to 2,000 per year, and that the current annual supply from schools is no more than 500. The need referred to applies to individuals having five or more years experience in physics in the sense of Section 1 (b) above (*i.e.*, at least one year of study or experience after the bachelor's degree). It does not include the much larger need for individuals well enough prepared in mathematics and physics for training in technical war operations. This need has been officially estimated at more than 100,000. The War Policy Committee considers this a very conservative estimate.

Accordingly, it is urged upon officers and faculty members of high schools, colleges and universities to recommend immediately that students enroll in courses in fundamental physics and their prerequisites in mathematics, whatever the stage in the student's educational career. The recommendation should be made only to students who possess natural aptitude for these studies. Such guidance for the student will to a marked degree increase his value to his country in this critical time.

Advisers of students may wish to point out to the latter that the study of physics (irrespective of any post-war career) is immeasurably helpful in any walk of life, because such study improves the ability to understand the new physical environment which man is creating for himself, and which, far more even than now, is bound to exert a major influence upon social, political and economic trends.

Moreover, great new developments now appearing behind the veil of war secrecy are, beyond all possibility of doubt, establishing the basis for unprecedented peace-time applications of physics in industry. Some of the greatest of these are along lines not yet developed as branches of engineering. They give promise of opening large and fruitful fields for the useful and profitable employment of those well equipped with a broad, fundamental training in physics.

The committee recommends to high schools that they emphasize mathematics through trigonometry and that in teaching physics the aim should be to give a well-planned, thorough course in the fundamentals of the subject. Unless the high school is properly equipped to offer specialized training in the applications of physics, it should leave this to the higher institutions.

To colleges and universities the committee recommends making provision for the most advanced courses for which students are qualified and, where facilities are suitable, the establishment of intensive courses, with laboratory practice, in electronic devices and high frequency circuits.

(4) Special Training of Physicists

Since the demand for physicists exceeds the supply which can be expected from the normal operations of schools and colleges, this committee endorses the program of special agencies operating to supplement this supply.

(5) Use of Physicists

The need for physicists in the total war effort is so vital, and the demand so greatly exceeds the supply, that it is essential that every available individual trained in physics be placed in a position in which full use is made of that training. The committee therefore would strongly endorse the adoption of any policies and regulations by the Selective Service System, personnel divisions of the Armed Services and other government agencies concerned to achieve this end more effectively.

SPECIAL ARTICLES

THE BIOCHEMICAL SPECIFICITY OF SULFANILAMIDE AND OF OTHER ANTIBACTERIAL AGENTS

Evidence was given from this department[1] which led to the hypothesis that the antibacterial action of sulfanilamide was due to its competitive inhibition of enzymes which normally interacted with *p*-aminobenzoic acid or a closely related substance. The antag-

[1] D. D. Woods, *Brit. Jour. Exp. Path.*, 21: 74, 1940.

onism between these two compounds has now been frequently confirmed, but Johnson,[2] on the basis of a reversal with urethane of the effect of sulfanilamide on luminous bacteria, questioned the hypothesis. We have found that urethane specimens, under certain conditions, may antagonize growth inhibition of *Streptococcus haemolyticus* and *Escherichia coli* caused by sulfanilamide, but that these conditions are limited and illustrate well the reasons for the original hypothesis. The findings are as follows:

(1) Much more urethane than *p*-aminobenzoic acid is necessary to antagonize the antibacterial action of a given quantity of sulfanilamide (Table I). Thus 1

TABLE I

THE DIFFERENT EFFECTS OF URETHANE AND *p*-AMINOBENZOIC ACID

Conditions of testing: *Strep. haem.* (Group A) was grown as previously described[1] with 10^{-7} *M* pantothenate.

Addenda		Growth after (days)		
Sulfanilamide, $M \times 10^{-5}$	Reversing agent, *M*	1	2	3
0	0	+	+	+
5	0	0	0	+
5	*p*-aminobenzoate, 2×10^{-3}	+	+	+
5	*p*-aminobenzoate, 4×10^{-9}	0	+	+
5	urethane, 10^{-2}	0	+	+
5	" 5×10^{-3}	0	+	+
5	" 5×10^{-4} and less	0	0	+
10	0	0	0	0
10	*p*-aminobenzoate, 4×10^{-3}	+	+	+
10	*p*-aminobenzoate, 4×10^{-9}	0	0	+
10	urethane, 5×10^{-3} to 5×10^{-6}	0	0	0
50	0	0	0	0
50	*p*-aminobenzoate, 4×10^{-7}	+	+	+
50	*p*-aminobenzoate, 8×10^{-3}	0	0	0
50	urethane, 5×10^{-3} to 5×10^{-6}	0	0	0

molecule of sulfanilamide is antagonized by about 1/5,000th of a molecule of *p*-aminobenzoic acid, but between 1 and 100 molecules of urethane were found necessary, and this effect was not reproducible with certainty. It is difficult to picture the mode of action of so small a proportion of *p*-aminobenzoic acid except by a specific enzyme mechanism,[3] but this does not necessarily apply to urethane.

(2) The urethane antagonism was shown only towards low concentrations of sulfanilamide, which were just anti-streptococcal. With slightly different concentrations the urethane had no reversing activity or was inhibitory. Five times this limiting concentration of sulfanilamide was not antagonized by many times the concentration of urethane. The urethane effect thus can not be said to parallel that of *p*-aminobenzoic acid, which can be effective against 50 times such a concentration of sulfanilamide. More *p*-aminobenzoic acid is needed to antagonize such higher concentrations of sulfanilamide, the quantities being roughly proportionate. The constancy of the ratio Cs/Cp, where Cs is the minimal concentration of sulfanilamide necessary for bacteriostasis in the presence of a concentration Cp of *p*-aminobenzoic acid, is consistent with sulfanilamide acting by inhibition of an enzyme normally reacting with *p*-aminobenzoic acid. Their similarity in structure makes this feasible. The non-competitive type of antagonism shown by urethane specimens is already known to be given by methionine,[4] which is structurally entirely unrelated to sulfanilamide. It has, however, been indicated by Harris and Kohn[4] that this action is consistent with *p*-aminobenzoic acid being the compound primarily affected by sulfanilamide. Methionine is regarded as biochemically related to *p*-aminobenzoic acid in that the acid is necessary for the normal production or metabolism of methionine.

No mechanism is suggested for the action of urethane. Antagonistic effects of inhibitory compounds are, however, well known under the term "chemotherapeutic interference." Cases of such interaction which have been investigated are, like the effects with narcotics quoted by Johnson,[2] not necessarily between structurally related compounds. Specific biochemical mechanisms can, however, be given,[5] such as the inactivation of hydrogen transporting systems by acriflavine and their replacement by methylene blue. This is in distinction to the suggestion[2] of promiscuous interaction between inhibitors and illustrates the general tendency to biochemical definition of pharmacological action rather than *vice versa*. An approximation to biochemical localization of narcotic action has been made by Michaelis and Quastel.[6]

(3) Other antibacterial agents are now known which in the manner of sulfanilamide are related to

[2] F. H. Johnson, SCIENCE, 95: 104, 1942.

[3] This large difference between the interacting quantities of *p*-aminobenzoic acid and sulfanilamide has been given as an argument against a competitive mechanism for the action of sulfanilamide (S. D. Rubbo and J. M. Gillespie, *Nature*, 146: 838, 1940) and has been repeatedly quoted as such (*e.g.*, by Johnson). The argument is now abandoned or no longer emphasized by its authors (*cf.* S. D. Rubbo and J. M. Gillespie, *Lancet*, I: 36, 1942) and is in fact no objection to, but is best interpreted in terms of competitive enzyme inhibition.

[4] H. I. Kohn and J. S. Harris, *Am. Jour. Physiol., Proc.*, 133: 354, 1941; E. Strauss, J. H. Dingle and M. Finland, *Jour. Immunol.*, 42: 313, 1941; J. S. Harris and H. I. Kohn, *Jour. Pharmacol.*, 73: 383, 1941.

[5] N. von Jancso and H. von Jancso, *Z. Immunforsch.*, 88: 275, 1936; H. McIlwain, *Biochem. Jour.*, in press; summarized in *Lancet*, 2: 762, 1941.

[6] M. Michaelis and J. H. Quastel, *Biochem. Jour.*, 35: 518, 1941.

growth essentials. The "narcotic" hypothesis gives no expectation of mutual specificity between their effects. Such does, however, exist (Table II) and is readily

TABLE II

SPECIFICITY OF ANTIBACTERIAL AGENTS

Organism and reference to conditions of testing	Addenda		Growth
	Inhibitor, *M*	Metabolite, *M*	
Strep. haem.[1] *Bact. coli*[8]	0	0	+
	sulfanilamide, 3×10^{-4}	0	0
	"	*p*-aminobenzoate, 10^{-7}	+
	"	pantothenate[11], 10^{-7} to 10^{-4}	0
	"	nicotinamide[11], 10^{-7} to 10^{-4}	0
Staph. aureus[9]	0	0	+
	pyridine-3-sulphonamide, 10^{-2}	0	0
	"	*p*-aminobenzoate, 10^{-7} to 10^{-4}	0
	"	pantothenate, 10^{-7} to 10^{-4}	0
	"	nicotinamide[11], 10^{-5}	+
Strep. haem.[7] *Diplococcus pneumoniae*[10] *C. diphtheriae*[10]	0	0	+
	pantoyltaurine, 10^{-4}	0	0
	"	*p*-aminobenzoate, 10^{-7} to 10^{-4}	0
	"	pantothenate[11], 10^{-6}	+
	"	nicotinamide[11], 10^{-7} to 10^{-4}	0

explained in terms of competitive enzyme inhibition. Thus the inhibition by pyridine-3-sulfonamide is unaffected by the presence of *p*-aminobenzoic acid or pantothenic acid, but is antagonized by a definite fraction of its concentration of nicotinic acid. Pantothenic acid, but not nicotinic or *p*-aminobenzoic acids, reverses the inhibition due to pantoyltaurine.

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THE EFFECT OF INSULIN SHOCK ON LEARNING IN THE WHITE RAT

SINCE its introduction by Sakel, insulin shock has been successfully used in the treatment of certain cases of dementia praecox and allied psychiatric and psychoneurotic conditions to bring about a remission of the symptoms which in certain cases has lasted indefinitely. There has been, as yet, no agreement as to the theory of its action, although there is no doubt that a cerebral anoxia is produced, with which the therapeutic effect is associated and upon which it is probably dependent. It occurred to one of us that the psychopathological symptoms might be regarded as recently formed habits of response, with younger and metabolically more unstable synaptic patterns of neuronal associations involved. If this were true, the more recently formed habit pattern should be more easily broken up, because of the effects of the cerebral anoxia. It was decided to test this hypothesis by observing the effect of insulin shock on habit formations in the experimental animal.

This is a preliminary report of a study involving the effect of insulin shock on habits of varying degrees of stability and age in the white rat. Exploratory observation established a tentative optimum dosage as one unit of insulin per 12 grams of body weight. In the exploratory group of animals, this medication caused a state of lethargy and/or coma lasting about two hours with a latent period of approximately 40 minutes. In almost half of the cases, there occurred severe convulsive seizures in which movements of the head region were particularly pronounced. All animals seemed to be normal within eight hours after injection.

Two mazes differing in complexity and type constituted the bases for the learning situations. The first group of animals began on a multiple-unit, elevated T maze. When this had been mastered to a criterion of 9 perfect runs in a sequence of 10 trials, 100 additional runs were made. Upon completion of this overlearning, training was begun on a linear arrangement of the Warner-Warden multiple-unit alley maze. The same criterion of learning was used, but the additional overlearning was omitted. During the learning of the alley maze no practise was given on the elevated maze. As soon as an animal had learned both mazes it was given 20 trials on each maze separately. Any animal making more than two errors in this stage was discarded. Following the test period, each rat was injected with the appropriate dose of insulin. Twenty-four hours after injection, the animal was again given 20 trials on each maze. A similar procedure was followed for the second group except that training was begun on the alley maze and the elevated maze habit was made the younger and less well-established habit. All rats were males.

The results are given in the appended table. It will be noted that, because of the rotation of groups, the first six animals who began their training on the elevated maze are found in the lower right side of the table, when the newer or alley habit is considered. That is, rat No. 1 began on the elevated maze and continued on the alley maze, whereas rat No. 7 reversed this procedure.

The present report will deal only with comparisons in terms of total errors during the pre-post-shock test

[7] H. McIlwain, *Brit. Jour. Exp. Path.*, 20: 330, 1939.
[8] P. Fildes, *ibid.*, 19: 239, 1938.
[9] H. McIlwain, *ibid.*, 21: 136, 1940.
[10] H. McIlwain, *ibid.*, in press; summarized in *Chem. Ind.*, 61: 96, 1942.
[11] Low concentrations of these compounds are in some cases necessary for growth, and were then present in the inhibited cultures; further quantities (those quoted) were necessary for reversal.

periods and on the learning of new and old habits. The means for the various groups are as follows:

Older habits

Elevated maze, pre-shock, .33, post-shock, 6.0
Alley maze, pre-shock, .83, post-shock, 4.83

Newer habits

Elevated maze, pre-shock, .50, post-shock, 11.00
Alley maze, pre-shock, .50, post-shock, 15.33

The conclusions from the above results seem to point to a more severe impairment of the newer and less overtrained habits. This statement is bolstered by the small size of the differences between the various habits during the pre-shock test period. Using Fisher's T test to determine the significance of the obtained differences we find that neither of the comparisons between the pre-shock tests are of statistical reliability. The P values for these differences are between .7 and .9.

The P values for the comparisons between the new and old habits in terms of post-shock differences are .075 for the elevated maze and less than .01 for the alley maze. In other words, the insulin shock seems definitely to impair the learning of a recently acquired alley maze habit and probably to impair the learning of a recently acquired elevated maze habit. No definite impairment can be found for the learning of older habits either on the elevated or alley maze.

TABLE I

EFFECT OF INSULIN SHOCK ON ERROR SCORES OF RATS

Elevated maze (old habit)			Alley maze (old habit)		
Subject number	Pre-shock errors	Post-shock errors	Subject number	Pre-shock errors	Post shock errors
1	0	8	7	1	3
2	1	6	8	1	6
3	1	9	9	1	4
4	0	5	10	0	4
5	0	5	11	2	10
6	0	3	12	0	2
(new habit)			(new habit)		
7	0	5	1	1	10
8	1	15	2	0	12
9	0	6	3	1	11
10	0	18	4	0	24
11	0	12	5	0	16
12	2	10	6	1	19

Each entry under "errors" represents the sum of 20 trials.

In the psychiatric conditions in which insulin shock has been employed, the symptoms are relatively recent cerebral manifestations as compared with the behavior acquired during the pre-morbid phases of the individual's development. These results with the experimental animal would seem to confirm our hypothesis of their relative susceptibility to metabolic shock applied to the cerebral patterns behind them. We are continuing our experiments and shall carry out similar ones with metrazol shock and electro-shock which also produce their therapeutic effects by the production of a cerebral anoxia.

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TOXIN FORMATION BY CERATOSTOMELLA ULMI

SINCE the discovery of the Dutch elm disease, caused by *Ceratostomella ulmi* (Schwarz) Buisman, in 1919, gums and tyloses have been observed commonly plugging xylem vessels of affected elm trees.[1,2] It has been assumed that wilting and decline of diseased elms are entirely the result of a "drouth" reaction, caused directly by the plugging of the vessels.

In the case of many vascular diseases of plants the concept that wilting and necrosis result primarily from plugging of xylem elements with hyphae, gums and tyloses has been largely replaced during the past twenty years by evidence that a toxin is the primary disease factor. Many of the fungi causing this type of disease, as well as other pathogenic fungi, have been shown to produce toxic substances which, on being transported upward in the vessels, can cause symptom appearance considerably in advance of the pathogen. Linden, Zenneck and Gunther[3] and Clinton and McCormick[4] have speculated that the symptoms produced by *Ceratostomella ulmi* might be the result of toxin production, but these authors did not present experimental evidence.

As the result of experiments begun here in 1940 it has been found that *C. ulmi* in culture produces a soluble toxic substance which is evidently the primary factor in the production of Dutch elm disease symptoms. This toxin is produced when the fungus is grown on a liquid nutrient solution containing yeast extract in addition to other nutrients. The fungus grows very poorly on the standard liquid synthetic media, but good mat formation is obtained when essential growth factors are provided by adding yeast extract, as in the following solution: KH_2PO_4 1.5 g., $MgSO_4 \cdot 7H_2O$ 1.0 g., $FeCl_3$ 0.01 g., asparagin 2.0 g., dextrose 30 g., Bacto yeast extract 2 g. and distilled water 1,000 cc.

Toxicity is tested by filtering off the fungus, after 12 to 25 days growth on the nutrient solution, injecting the sterile filtrate into small American elm trees, and testing its effect on various plant cuttings. When the toxin was freed of the fungus by Berkefeld filtra-

[1] M. G. Schwarz, *Meded. Phytop. Labor. Willie Comm. Scholt. Baarn*, 5: 74 pp., December, 1922.

[2] C. J. Buisman, *Tijdschr. Nederl. Heidemaatsch.*, 40: 338–345, October, 1928.

[3] G. V. Linden, L. Zenneck and Gunther, *Centralbl. Bakt. Abt.* II, 69: 340–351, February 28, 1927.

[4] G. P. Clinton and F. A. McCormick, *Conn. Agr. Expt. Sta. Bull.*, 389: 697–752, October, 1936.

tion and injected into healthy elm seedlings, typical symptoms of the Dutch elm disease appeared. Young leaves wilted and died, older leaves curled upward or developed necrotic spots; cell walls were discolored for long distances from the injection hole and dark gums appeared to plug the vessels. Tomato, elm, snapdragon and maple cuttings placed in tubes containing the filtrate from fungus cultures wilted severely, usually in from one to four hours. Uninoculated nutrient solution did not affect elm trees or plant cuttings, nor did control solutions adjusted to the pH of the fungus filtrate.

Five potted elms in the greenhouse and 10 elms three to four feet tall growing in nursery rows were injected with filtrate from a 25-day-old culture. Within three days the above-mentioned symptoms appeared on all trees. An average of 20 per cent. of the leaves were killed, and the average height to which the wood discoloration extended above the injection hole was 24 inches on five trees injected with 75 cc of filtrate; comparable figures for five trees injected with 200 cc of filtrate were: 29 per cent. leaf kill and 29 inches for the average height of discoloration. Tests on the time factor in relation to toxin production showed slight toxin formation after three days growth of the fungus and optimum production after a 12-day incubation period. As expected, toxin production is closely related to vigor of growth of the fungus culture.

Thermostability of the toxin after boiling for five minutes indicates that it is not enzymatic. The toxin is adsorbed by activated charcoal, is removed from aqueous solution by an excess of toluene and is antidoted by several organic chemicals.[5] Further work on the identity of the toxic substance is in progress.

Thus it has been demonstrated that symptoms similar to those of the Dutch elm disease can be reproduced by injecting a sterile filtrate from cultures of the fungus. This indicates that the same type of reaction takes place in the tree and that wilting and necrosis of leaves and discoloration of the wood are a response to the fungus toxin produced in the tree in the same way as they are to the fungus toxin produced in culture. As infection develops and more toxin is formed, gum and tylosis formation undoubtedly increases until the plugging of vessels becomes the important secondary disease factor. As a result of this plugging, water conduction may be shut off entirely and the tree dies unless new wood can be formed.

If, as these results indicate, *C. ulmi* is effective in killing elm trees primarily because of toxin production, several different approaches to attempted control of the disease by chemotherapy are indicated. As stated recently,[5] it may not be necessary to attempt to *kill* the pathogen by chemotherapy. This has been the prevailing endeavor in the past, but if the fungus toxin can be antidoted for a sufficient time by injection of a suitable chemical, the tree may outgrow and wall off the infection, particularly in a vascular disease of this type. Thus the chemical nature of the toxin becomes important in selecting chemicals which may affect it in the diseased plant. Chemotherapy, of course, can also attempt to affect the processes causing toxin production, by injecting chemicals with the aim of directly interfering with some phase of metabolism of the pathogen.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A PHOTOELECTRIC MEMBRANE MANOMETER*

THE device to be described was designed for the purpose of making an accurate record of the pressure changes in the cardiovascular systems of various animals, especially the dog and turtle. Probably the most successful method has been used by Wiggers[1] and others, who have had good results with it in the dog. This method uses a membrane manometer similar to that shown, except that a complicated adjusting mechanism is necessary. The light source is a powerful carbon arc focused on the mirror, and the light reflected must be projected fifteen feet to a moving strip of photographic paper. This great distance is needed to provide sufficient optical magnification. Auricular pressures in the turtle would be almost impossible to record with this instrument. Because of the inconvenience of the method, its lack of sensitivity and the difficulty of making simultaneous cathode ray oscillograph records of the electrical changes on the surface of the heart it was decided to try to find some electronic means of pressure recording.

Several methods seemed promising, among them the variable resistance devices, on which Edison took out dozens of interesting patents in his search for a practical microphone. These devices were not sufficiently stable to return to the base line when the pressure was removed or had some other disadvantage. The piezoelectric pressure recorders will not record accurately a sustained pressure increase. Using the diaphragm as a condenser microphone has the same objection.

[5] J. G. Horsfall and G. A. Zentmyer, 17th Proc. Nat. Shade Tree Conf., pp. 7–15, 1941.

* Supported in part by a grant from the Wisconsin Alumni Research Foundation.

[1] C. J. Wiggers, "The Pressure Pulses in the Cardiovascular System." New York: Longmans, Green and Company. 1928.

If, however, the changing capacitance be used to frequency modulate an oscillator tuned to the sharply sloping portion of the selectivity curve of an intermediate frequency amplifier, and the amplifier output rectified by a diode, the rectified voltage will be in effect a directly coupled function of the voltage. This method was tried and worked quite well, but was abandoned because of mechanical difficulties in making a condenser microphone small enough to go into the heart. The principle has been used in a myograph, which will be described in a later article.

The method finally used is shown in the diagram (Fig. 1). The various parts are mounted on a tri-

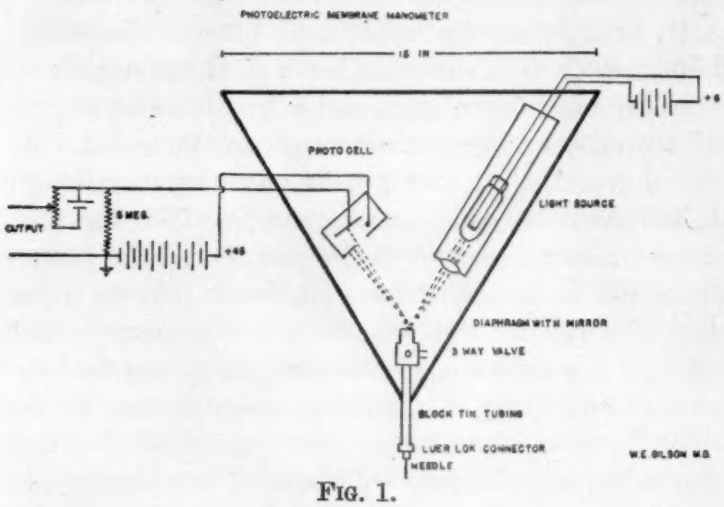

FIG. 1.

angular piece of one-half inch steel. The light source is a 75-watt exciter lamp of the type used in sound-on-film motion picture projectors. A single lens is used to focus the light on the mirror, which reflects a cone of light toward the photocell, an RCA 921 or 922. The apparatus is so adjusted that with zero pressure a small part of the light falls on the photocell. As the pressure applied to the diaphragm increases, the mirror is deflected and more light falls on the photocell. This produces an electrical change which is amplified by a push-pull direct coupled amplifier[2] and causes a deflection of the cathode ray spot, the amplitude of which is controlled by varying the gain of the amplifier.

The entire pressure system is filled with citrate solution. The three-way valve provides for connection between the diaphragm chamber and the side arm, for calibration against a mercury column, between the diaphragm chamber and the needle for record taking, and between the side arm and the needle for washing out the pressure system.

The output is linear over a wide range, as determined by accurate calibration. The device is easily adjusted and very flexible. It may be used to record the 160 mm Hg pressure change in the dog ventricle or the 1 mm Hg change in the turtle auricle. To my knowledge the latter has not been accurately recorded previously.

The frequency response is good, and entirely dependent on the mechanical design of the membrane manometer. This design is discussed by Wiggers.[1] The first part of his book would be of value to any one interested in using an instrument of this type.

The results and records obtained may be seen in papers by Eyster, Meek and Goldberg.[3, 4]

The photoelectric membrane manometer is not restricted in its application to cardiovascular research, but should be of value in a wide variety of physical and engineering problems.

In summary, its advantages over optical projection are:

1. Greater sensitivity.
2. Variable sensitivity. Pressure changes of any magnitude may be represented by any desired deflection of the cathode ray spot, simply by changing the amplifier gain.
3. Electrical changes may easily be recorded simultaneously.
4. Insertion of the needle is easy, because the entire device may be moved as a unit to any position desired.
5. It is not necessary to work in a room twenty feet in length.

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[2] H. Goldberg, "Electrical Engineering," January, 1940, Trans. p. 60.

[3] H. Goldberg and J. A. E. Eyster, *Am. Jour. Physiol.*, 131: 416, 1940.

[4] J. A. E. Eyster, Walter J. Meek and Harold Goldberg, *Am. Jour. Physiol.*, 131: 760, 1941.

BOOKS RECEIVED

BELDING, DAVID L. *Textbook of Clinical Parasitology.* Illustrated. Pp. 888. D. Appleton-Century Company, Inc.

BELL, R. P. *Acid-Base Catalysis.* Pp. 211. Oxford. $3.50.

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HACK, JOHN T. *Prehistoric Coal Mining in the Jeddito Valley, Arizona.* Illustrated. Pp. 24. Cambridge.

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Science, Philosophy and Religion. A symposium. Edited by LYMAN BRYSON and LOUIS FINKELSTEIN. Pp. 559. Conference on Science, Philosophy and Religion in Their Relation to the Democratic Way of Life, Inc.

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Science Service, Washington, D. C.

NIGHT VISION AND DAY VISION

YOUR eyes have two-way vision—one set of sense organs for daylight seeing and the other for darkness. Both operate at the same time only when the light is about as bright as full moonlight. Differences between the eye as a night-vision instrument and the daylight eye, important for night warfare and blackouts, were described by Professor Selig Hecht, of the Laboratory of Biophysics, Columbia University, at a meeting of the Physical Society of Pittsburgh.

Night eyes are thousands of times more sensitive than are day eyes. The night pilot who has been flying in the dark for an hour or more could see the light of a candle twelve miles away even if it were exposed only for a thousandth of a second. If it burned continuously, he could see it over 200 miles away, were it not for interference of fog and haze at night, or for smoke and the curvature of the earth. For this reason, Professor Hecht explained, it is dangerous in a blackout for any one to use a flashlight, or light a match or even a cigarette in an open space. The flame of a match can be seen by a pilot many miles away.

Night eyes can not see as sharply as day eyes. When it is necessary to recognize small forms and slight differences in shade and shape, you must have good lighting and use your daylight eyes. You need your day eyes to read an instrument or your watch. Night eyes are color-blind. Colored lights look colorless to your night vision. If you see them as red or green or blue, you are using your cone or day vision.

But the brightness of different colors is not the same when you see them at night as when you see them in the day time. This is particularly important when you want to use colored lights to see best during a blackout without giving aid to the enemy. Blue and green are easiest to see. Red and orange, which seem so conspicuous in the day, are hardest to see at night. Nothing could be more dangerous than the use of blue lights during blackouts.

Dr. Hecht said that "For reasons which are none too clear at present the notion has gained prevalence that blue lights should be used to illuminate objects, and that these would furnish less light to distant aviators because blue is supposed to be a dim light. Indeed, the Germans and the English, and at the beginning we ourselves, used blue lights during blackouts."

The reason why red lights are safer than blue was explained as follows: When we need a light during a blackout—to watch a dial, read a compass or a road sign—we must use our day vision for this purpose. The enemy aviator, however, needs only his night vision in order to spot that light. Your night eyes and your day eyes happen to be equally sensitive to red light. If you see the light at all, you can also see it with your color-sensitive day eyes and you have the day vision's advantage of ability to recognize shapes.

But for blue light, your night vision is 1,000 times more sensitive than is your day vision. In other words, if you have enough blue light so that you can see a road sign, the light will be 1,000 times as bright to the night-seeing pilot as would be a red light of equal effectiveness.

A NEW CHEMICAL REMEDY FOR TUBERCULOSIS

HOPE for a chemical conquest of tuberculosis is encouraged by successful results in the treatment of thirteen tuberculous patients with Promin.

Promin, a distant relative of the sulfa drugs, can not yet be called a cure for tuberculosis. But the thirteen patients showed definite signs of improvement within two months after getting this new treatment, and x-ray pictures showed the diseased areas of the lungs were nearly or entirely healed within four to six months. Dr. H. Corwin Hinshaw, Dr. Karl Pfuetze and Dr. William H. Feldman, of the Mayo Clinic and Foundation, reported these results at the Philadelphia meeting of the National Tuberculosis Association.

The thirteen patients were in the early stages of tuberculosis with sputum being coughed from the lungs, but no extensive destruction or degeneration of the lungs. They had the kind of lung condition which often heals spontaneously without chemical treatment. The number of patients is too small to be sure that Promin was responsible for the healing. It is concluded, however, that further trial on patients of Promin and related drugs of the sulfone series seems justified.

Altogether, 106 patients have been given Promin, following the successful use of this chemical in treatment of human tuberculous infection in guinea pigs. A special study was made of 36 patients with tuberculosis of the lungs whose lungs had not been collapsed and who had been under treatment for from four to twelve months. It was reported that most favorable results were observed on "exudative pulmonary lesions of recent origin without extensive destruction of tissue and without marked fibrosis." There were thirteen patients who showed such rapid signs of improvement. Cavities in the lungs closed in more than ten patients and tuberculosis germs apparently disappeared from the sputum of eleven patients. Fever declined significantly in ten of the eighteen patients. On the unfavorable side, the doctors reported one patient developed a new and progressive lesion and four patients in the group died, three being obviously in the last hopeless stage of the disease before the treatment was started.
—JANE STAFFORD.

SOILLESS GARDENING

SUCCESSFUL growing of plants with their roots dangling in an atmosphere saturated with water vapor, instead of being embedded in soil, has recently been accomplished and is expected to become an important contribution to the science of soilless gardening.

Dr. Walter Carter, entomologist for the Pineapple Research Institute, Honolulu, Hawaii, tells of his adap-

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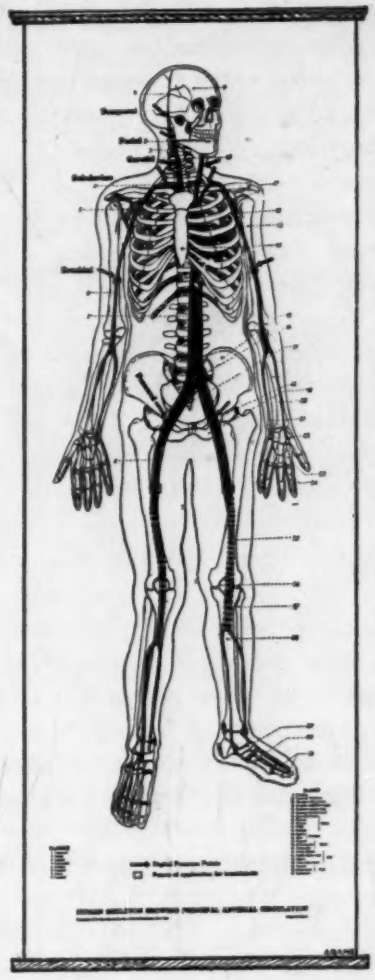

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tation of the method in *Phytopathology*. In his studies of root damage to pineapple plants caused by infestation with mealy bugs, Dr. Carter found that the necessary examination and sampling of roots during the experiment produced considerable mechanical injury. To overcome this difficulty, the water vapor method was developed.

This method consists of setting the plants in holes in the top of a fairly tight wooden box. Inside the box is an atomizer such as is used in air-conditioning apparatus and in keeping green vegetables from wilting in retail stores. In this device water from an ordinary main goes through a valve to form a fine jet which impinges on a flat plate. The resulting spray keeps the air in the box saturated with water vapor.

The pineapple cuttings soon begin to grow and develop roots which hang down inside the box. More vigorous growth is produced, Dr. Carter found, if a nutrient solution is added to the spray. To accomplish this, he connected an eight-quart tank in parallel with the water supply. A needle valve from the main line leads into the bottom of the tank and a pipe from the top makes a T-joint with the pipe leading to the atomizer. The fresh water gradually replaces the nutrient solution. One tankful lasts about three days. The liquid in the tank becomes progressively more dilute, but this does no harm to the plants. When the nutrient solution needs replacing, the needle valve is closed and the tank drained and refilled.

The water vapor method has several advantages over other soilless methods. Once set up it is almost automatic, requiring no adjustment of acidity or refilling of jars. Root aeration is better at all times, and no trouble is encountered with algae or other contaminating organisms.

RUBBER PRODUCTION IN HAITI

RICH, verdant Haiti, where once the tom-toms of Voodoo rites boomed, has settled down to hard work among her once-abandoned rubber trees, and in cooperation with this country is producing rubber at the rate of 350 pounds per month.

Some 2,500,000 new rubber plants have been set out, and estimates reveal at least 100,000 acres which could give the United States a large near-by supply. Haiti is tapping her old trees with newest, proved techniques, experimenting with splitting Hevea seeds to get two plants from one seed, growing rubber seedlings.

Behind this forward-looking enterprise is a unique organization, begun well before the war in the Pacific. It is called the Haiti-American Society for the Development of Agriculture. It was formed last year as the outcome of discussions with United States agriculture advisers. It is a cooperative venture between this country and the South American Republic which a few years ago faced economic disaster from wartime loss of trade.

Foreseeing the Pacific tragedy, the society began preparing itself to supply this country with rubber, fibers, drugs, now cut off from the Netherlands Indies, Philippines, Malaya and India. Now the rubber plantations have a head start on the big job of increasing rubber planting in the Americas; the rubber enterprise is surpassed only by the Ford plantations in the Amazon valley.

Major operations, as reported by the president and general manager, Thomas A. Fennell, are:

Bayeux Division—This plantation has nearly a million growing rubber plants and about 2,500,000 rubber seeds. Tapping of old rubber trees at Bayeux has started.

Forests Division—A sawmill at Morne de Commissaires has been turned over to the society for operation. In the last three months of 1941 the mill cut about 100,000 board feet of pine lumber. A second and larger mill is being installed.

Grand'Anse Division—A state-owned tract of approximately 30,000 acres under preparation. About 1,000,000 Hevea seeds planted in nurseries.

An attempt is being made to develop handicrafts for Haiti's large labor supply. Samples have been sent to New York importers.

THE MANUFACTURE OF NYLON IN JAPAN

THE author, K. Hosino, research man for the Oriental Rayon Company, Ltd., according to the *Journal* of the Chemical Society of Japan, has analyzed nylon, the synthetic plastic fiber that has made the United States independent of silk. After he had determined how the molecules were put together, he duplicated them and then made modifications which he claims are improvements over the American product.

This procedure, reminiscent of pre-war tales of how Japanese mechanics would build a duplicate of any machine that Occidental manufacturers would sell to their employers, might give Japanese textile factories the means to compete to great advantage with nylon mills in this country and Europe. Japan has persistently refused to enter into any patent treaty with any foreign country, so that the du Ponts, originators of nylon and owners of basic patents thereon, will have no protection against Japanese attacks on their business, especially in the export market.

Nylon, the Japanese chemist states as a result of his analysis, is a "polyamide of hexamethylenediamine combined with adipic acid."

If Japan goes into the nylon business, the silk industry, already hard hit first by rayon and then by the cessation of American silk purchases even before the outbreak of war, may never come to full revival. It is reported that hundreds of thousands of mulberry trees have already been felled in Japan, to make room for more food-crop production. Quite possibly these groves may never be replanted. Silk may again become what it was in the Middle Ages and early modern times—luxury for the rich.—WATSON DAVIS.

SYNTHETIC CELLULOSE

BASIC understanding of cellulose, the stuff that cotton, wood and a thousand other useful substances are made of, was materially advanced by a paper presented at the recent meeting of the American Chemical Society by Dr. W. T. Haskins, Dr. Raymond M. Hann and Dr. C. S. Hudson, of the National Institute of Health, U. S. Public Health Service, at Bethesda, Md.

For the first time in the history of chemistry, the fundamental building block of cellulose, a compound known as cellobiose, was made synthetically by the three investigators. This does not mean that cotton plants, trees and all other of cellulose will presently be out of a job, Dr. Hudson stated in discussing the paper. Man will probably never be able to make cellulose as easily and cheaply as plants. But it does mean that science will have a better knowledge of how cellulose is put together, that knowledge can be turned to advantage in making such things as explosives, rayon, plastics and transparent wrappings, of better quality and at lower cost.

When cellulose was first analyzed, more than a hundred years ago, it broke down into molecules of common glucose. Subsequently it was found that these were united in pairs to make double sized molecules of a more complex sugar which was named cellobiose. Now for the first time it has been possible to make cellobiose artificially and to demonstrate that in the synthetic molecules the glucoses are tied together in exactly the same way that they are in the natural molecules.

At the same session, what might be termed the engineering properties of the cellulose molecule were discussed by Dr. R. F. Nickerson, of the Mellon Institute of Industrial Research. The microscopically fine cellulose fiber of cotton, wood pulp or other natural material is built of long, slender molecules, more or less aggregated into crystals, together with a high content of linked oxygen-hydrogen atoms. Cellulose molecules are not kinked as are wool and rubber molecules, which accounts for the lower degree of stretchiness and bounce to be found in cotton and similar materials. Understanding of these submicroscopic structural details is important in present-day efforts to find suitable cotton or other substitutes for hemp, silk and other "war-short" fibers.—FRANK THONE.

ITEMS

THAT puffed-up sand, known as silica aerogel, is about twice as good a heat insulator as any other substance, was reported at the Boston meeting of the American Institute of Chemical Engineers by John F. White, of the research department of Monsanto Chemical Company. The material is now being used chiefly in the insulation of high-temperature laboratory furnaces and extremely low-temperature chambers for the liquefaction and freezing of gases. When peace comes and new household refrigerators appear in the stores, the present three-inch walls can be reduced to one and a half inches, he said. The present six and a half cubic foot model can have its inside expanded to nine cubic feet without any increase of outside dimensions.

A NEW plastic filler material made from sawdust, scrap wood, cotton, plant fibers or other waste cellulosic materials was announced at the meeting by A. O. Reynolds, of the Northwood Chemical Company, and Raphael Katzen and Dr. Donald F. Othmer, of the Polytechnic Institute of Brooklyn. The filler material can be combined with phenolic resins in the proportion of three parts of filler to one of resin. This gives a plastic comparable to that obtained from one part filler to one part resin when ordinary fillers are used, according to the authors of the paper. Thus the present limited supplies of phenolic resins can be made to go twice as far. Or more phenol and formaldehyde can be saved for the munitions program.

DISCOVERIES at the National Bureau of Standards show how iron and steel can be heat-treated in airless furnaces to speed production in war industries. One of the difficulties in hardening or annealing ferrous metals through use of high temperatures in ordinary air has been the formation of oxide scale that must be removed by pickling, grinding or polishing. This costs time and money and delays the flow of production. Investigations by V. C. F. Holm, metallurgist at the bureau, show that if the heating is done in a practically inert atmosphere or in a vacuum furnace iron and steel can be heat-treated without oxidation.

REDUCTION of weight in airplane engines to less than one pound per horsepower, through the Wright Aeronautical Corporation's new method of forging cylinder heads, promises to give American airplanes a considerable edge over enemy combat aircraft in speed, altitude, load and range. The new forged heads are made by a process of extrusion through a die, and nine separate drop-hammer operations are eliminated. The cooling fins are cut on the exterior of the cylinders by a high-speed milling machine. The new head allows twelve to fifteen per cent. increase in power output without weight increase. The development is applicable to the big 2,000 horsepower engines that power such ships as the Douglas B-19 bomber.

BRAIN waves go on after death. It is not thought that this is a sign that brain activity of conscious, thinking variety continues after death. But experiments reported at the Boston meeting of the Federation of American Societies for Experimental Biology may lead to a greater knowledge of how nervous tissue like the brain functions. The experiments were reported by Dr. Morton A. Rubin, Dr. Hebbel E. Hoff, Dr. Alexander W. Winkler and Dr. Paul K. Smith, of the Worcester, Mass., State Hospital and Yale University School of Medicine. Brain waves are the records of electric currents discharged during brain activity, which scientists have been using in the study of such disorders as epilepsy. They were hailed, when first discovered, as being likely to throw as much light on brain functioning as the more familiar electrocardiograms shed on heart function. The discovery that these brain waves, and therefore the brain activity responsible for them, continue after death may make it necessary to revise some of the ideas of what the brain waves mean, as well as to reopen the question of what constitutes death. In cats brain waves continued for fifteen minutes after the animals had stopped breathing and their hearts had stopped beating. The deaths were of a rather special kind, even in these days of high explosives and other lethal devices. The deaths followed injections of the chemical elements calcium, potassium or magnesium. In death due to the cutting off of oxygen or of the blood supply to the brain, the brain waves stop within a few seconds. After the chemical deaths, the waves continued for fifteen minutes and might have gone on longer if the scientists had been able to continue their observations for a greater period.

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